MARCH 10, 1958 PRICE 50 CENTS

RESEARCH and DEVELOPMENT news edition

# Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN
RESEARCH AND DEVELOPMENT

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PRODUCT PLANNING with POLARIS, page 44

CAREER: ENGINEER OR MANAGER
see page 42

design
IS MORE THAN NUTS AND BOLTS
see page 38

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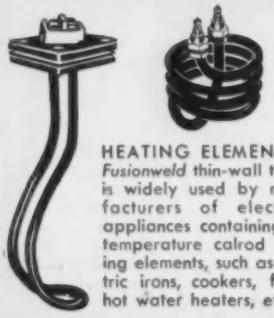
# TUBING AIDS by *Fusionweld*

## Spark Solutions to Production Problems



**HEATING ELEMENTS**—*Fusionweld* thin-wall tubing is widely used by manufacturers of electrical appliances containing low temperature calrod heating elements, such as electric irons, cookers, fryers, hot water heaters, etc.

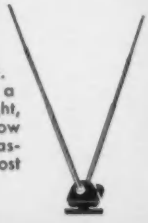
**OIL LEVEL INDICATOR TUBES**—Avon's low cost, high production fabrication and forming of steel tubing with new spot welding technique in attaching brackets, clips or fittings to *Fusionweld* thin-wall tubing has been widely adopted by most motor car manufacturers.

**TUBULAR PUSH RODS**—A current automotive development replacing solid steel push rods with *Fusionweld* steel tubing. These have swaged ends or hardened steel inserts (spot welded) in tubing ends. A high degree of concentricity is maintained with maximum run-out held to .020.

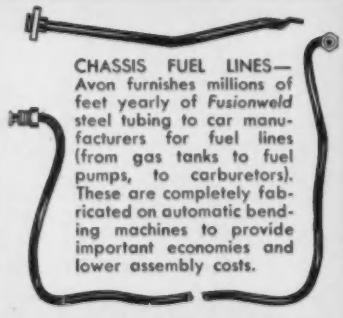
**GAS SPACE and WATER HEATER TUBES**—Several new developments by *Fusionweld* have cut costs by eliminating expensive brass fittings and non-ferrous tubing or pipe from thermostats to burners, replacing with low cost inverted flare nuts and one piece steel fittings brazed or spot welded to Avon steel tubing.

**ENGINE OIL FILTER TUBES**—For both internal and external use with brazed fittings attached. *Fusionweld* tubing can be beaded, swaged and sheared to meet specifications of motor car, truck and tractor manufacturers.

**MISCELLANEOUS APPLICATIONS**—*Fusionweld* thin-wall tubing is extensively used by toy manufacturers, umbrella and TV antenna makers, also for electric light fixtures, tubular furniture, etc. *Fusionweld* offers a tough, light weight, extremely ductile, low cost steel tubing easily formed for most requirements.



**OIL SPACE and WATER HEATER TUBES**—*Fussionweld* thin-wall tubing provide manufacturers of this and similar equipment with smart economies by replacing non-ferrous tubing and fittings with special steel fittings combined with *Fusionweld* steel tubing.



**CHASSIS FUEL LINES**—Avon furnishes millions of feet yearly of *Fusionweld* steel tubing to car manufacturers for fuel lines (from gas tanks to fuel pumps, to carburetors). These are completely fabricated on automatic bending machines to provide important economies and lower assembly costs.

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# IN THIS ISSUE...

## PRODUCT PLANNING WITH POLARIS

Three engineer-editors go through a key development process, using available data, market-potential figures, field of application, and competitive information (simulated in this case by Congressional testimony and Navy releases), and expert (?) advice (which, as usual, is of dubious value). Then an artist gives the product a suggested form. See page 44 for the interesting results . . . a possible way to launch the Navy's newest (and newsiest) ballistic IRBM missile. Five years ago, it was science fiction; today it is practical and possible.

*Another in the PE series of full-color stories. Watch for the next—next week in the Design Edition (over).*

# coming next week . . .

# the DESIGN edition for March 17,

FEATURING:

- **Textured steel.**
  When to use it, how it's made,
  tips on design and fabrication.
  With full-color illustrations of available designs.

- **Input-output analysis of mechanisms.**
  How the principle of virtual work
  gives rapid, accurate answers.

- **Ceramics from glass go commercial.**
  Latest information on Pyroceram
  with application and availability data.

- **Exotic metals seek employment.**
  For special structural or electrical
  problems, consider these "rare" metals.

- **Shock factors for impact loads.**
  Weaker supports may be better than stronger
  ones under impact. Charts show applicable factors.

- **Which adhesive for what?**
  How to choose and apply
  today's "stickums."

- **18 Wedge-action assemblies.**
  For temporary or
  semi-permanent assembly.

# Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R&D RESEARCH and DEVELOPMENT news edition

March 10, 1958 Vol. 29, No. 10


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# Product Engineering . . . . . SIDELIGHTS

R ESEARCH and D EVELOPMENT news edition

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●Testifying before a Congressional subcommittee, Dr. Murray Gell-Mann of California Institute of Technology described the anti-particle and the possible existence of anti-matter. A collision of matter and anti-matter would result in 100% matter-energy transformation—better than chemical fuels any day (rocket fuel experts please note—p. 23) though "it probably would have to be contained in an anti-bottle," adds Dr. Gell-Mann. To us the whole thing seems vaguely reminiscent of the "perfect solvent". But what about using one of those magnetic bottles? . . . or would you need an anti-magnetic anti-bottle?

●Engineers are asked to do just about everything these days. They are simultaneously designers, purchasing agents, expediters and, of course, managers (p. 40). If you're beginning to feel indispensable, try the experiment suggested by Rice Institute. Stick your finger in a bowl of water and notice the hole it makes when you pull it out.

●Last fall our "Why Don't They R & D?" editor suggested magnetic clothes fasteners to replace zippers and buttons (Oct. 7, p. 50). Now we hear from E. A. Scroe (a well-informed draftsman) that Mme. Margot Natique, a Paris fashion designer, experimented with such a system for an evening gown. M. Henri de Seigneur, a friend (sic) heard she intended a tryout at a party. He either carried a demagnetizer in person or installed it in a settee—no one ever found out. But the result was Mme. Natique's undoing and the . . . uh . . . principle was dropped.

●Recent reports on what the man-in-the-street thinks of satellites reconfirmed a favorite quote of ours. Nicholas Murray Butler, former president of Columbia University, once said that the world is made up of three kinds of people. The first group, a very small one, who make things happen . . . a somewhat larger group—who watch things happen . . . and the great multitude—who don't know what happens.


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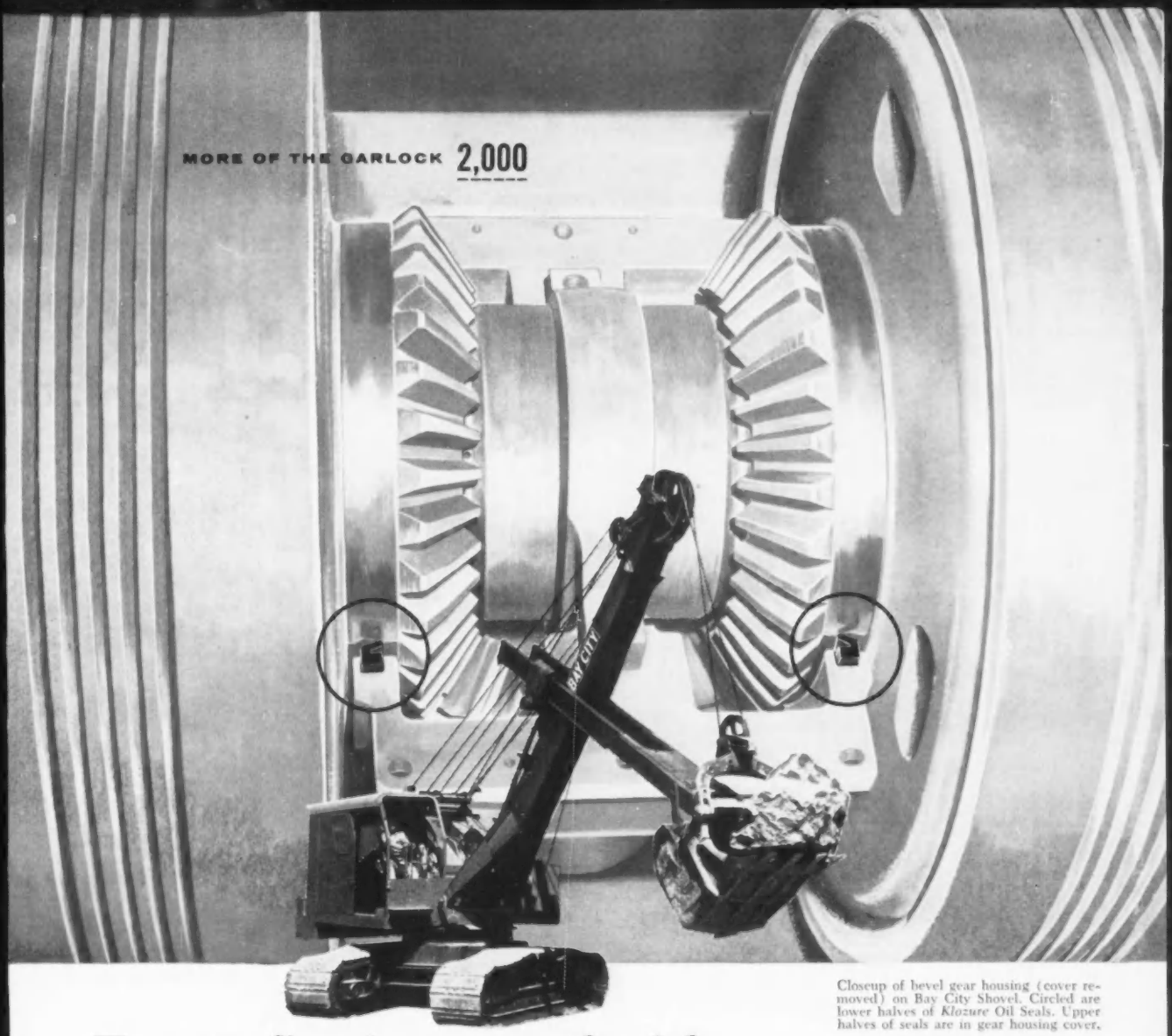


Closeup of bevel gear housing (cover removed) on Bay City Shovel. Circled are lower halves of *Klozure* Oil Seals. Upper halves of seals are in gear housing cover.

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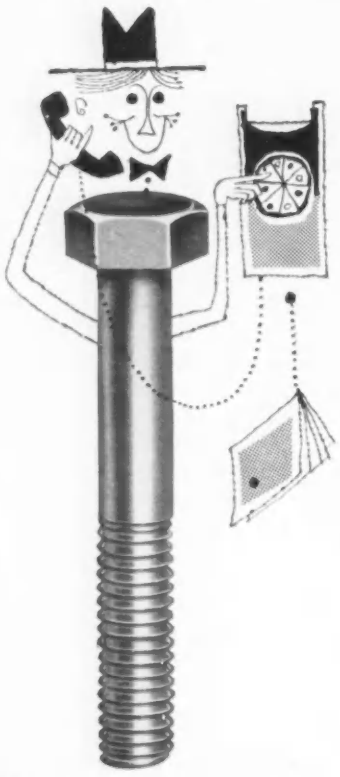

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# READER TO EDITOR

## Capitol Comments

*The following are some of the many comments on the editorial, "Why We Need to Know," Dec. 16, p. 24. A few reprints are still available.*

To the Editor:

There certainly is a wealth of sound thinking in the editorial from the Dec. 16 issue of *Product Engineering* The need for balance and perspective in our attitudes; for a greater public understanding of the problem; for intelligent appraisal of our errors rather than partisan efforts to smokescreen the past; for fewer "experts" and more do-ers, all are becoming more and more evident.

I am concerned that our short-range efforts and our preliminary successes will obscure the Nation's long-term requirements and lull us into a false sense of security. By emphasizing facts, and by giving them the widest possible dissemination, your magazine performs a public service of great merit.

—Richard Nixon
*Vice President of the U. S.*

. . . From the beginning, I have been trying to stress the fact that the real long-range danger rests less in missiles than in the gap between the American reservoir of trained minds and the growing Soviet reservoir of trained minds.

—Sen. Lyndon B. Johnson
*Texas*

. . . I was very much interested in the facts brought forth in your editorial. I believe that many of them need to be consistently emphasized in an effort to make America realistically take stock of her position.

—Gov. Albert D. Rosellini
*Washington*

. . . The editorial is extremely well done and pinpoints, in my opinon, both the situation we face and exactly what we can do about it. I thought the National Science Foundation an excellent vehicle when I joined in sponsorship of legislation creating it and bringing it into being. I am more convinced than ever now.

—Sen. Warren G. Magnuson
*Washington*

. . . It is one of the best I have seen on the subject of Sputnik and it incorporates many of the ideas that I have had for a long time. I was aware of the fact that our information on Sputnik was available some months prior to its being sent into orbit, and consequently, was a little disgusted with the newspaper coverage.

—Sen. Barry Goldwater
*Arizona*

. . . I found it very interesting reading and only regret that the facts and point of view it sets forth have not been more generally known.

—Donald A. Quarles
*Deputy Secretary of Defense*

. . . I do indeed agree with the editorial's emphasis on education and the long-term aspects of the struggle in which we are now engaged.

—Sen. Clifford P. Case
*New Jersey*

. . . I have been concerned for some time with the possibility that too many of us would use hysteria over the present space age as an excuse to lower the standards of American life and production. Certainly this is no time for us to neglect urban redevelopment, clean streams or many other important programs which will serve the entire nation.

I like your phrase, "we can place the emphasis on knowledge." To this end, we played host on January 28 and 29 to over 200 top educators, administrators, classroom teachers and lay persons in a probing search into our education program. Pennsylvania certainly hopes to do its best to produce more uncommon men in the mold of Penn and Franklin.

—Gov. George M. Leader
*Pennsylvania*

. . . one of the best articles I have read and I agree wholeheartedly with almost every statement made.

—Rep. Wm. Jennings Bryan Dorn
*South Carolina*

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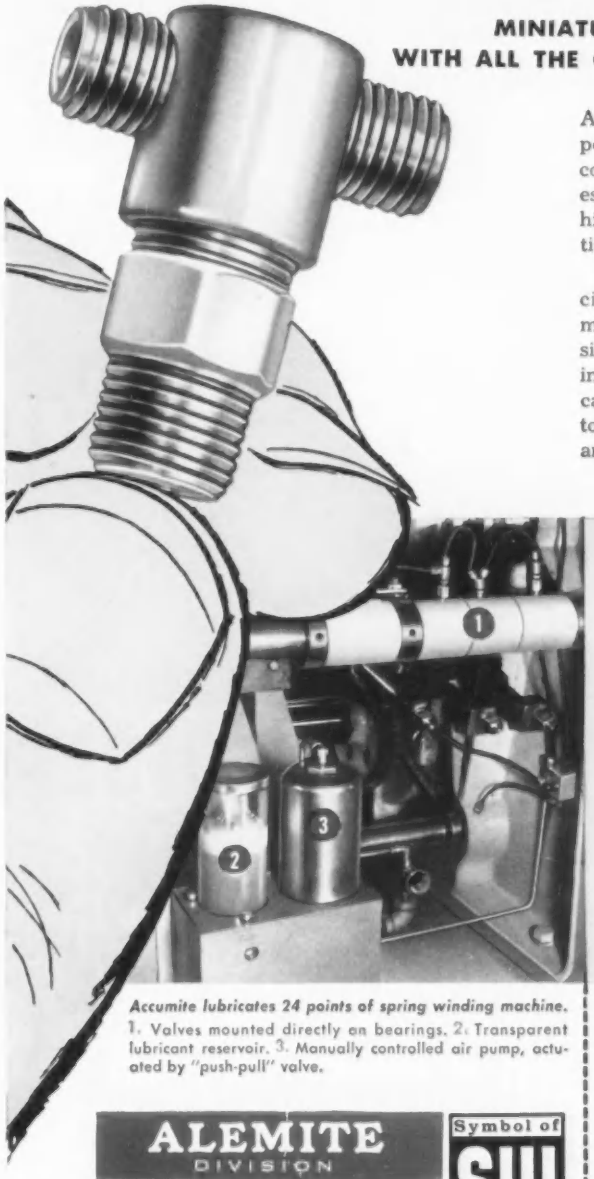


*Accumite lubricates 24 points of spring winding machine.* 1. Valves mounted directly on bearings. 2. Transparent lubricant reservoir. 3. Manually controlled air pump, actuated by "push-pull" valve.

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Doesn't your product deserve one? Wouldn't you like the added assurance of *customer* satisfaction that goes right along with Delco Products power—power backed by the world's largest independent electric motor service organization? Simply call your nearby Delco Products Sales Office or contact Delco Products, Dayton, Ohio.

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# American ...

## DEVELOPMENTS TO WATCH...

### Improved motor insulation . . .

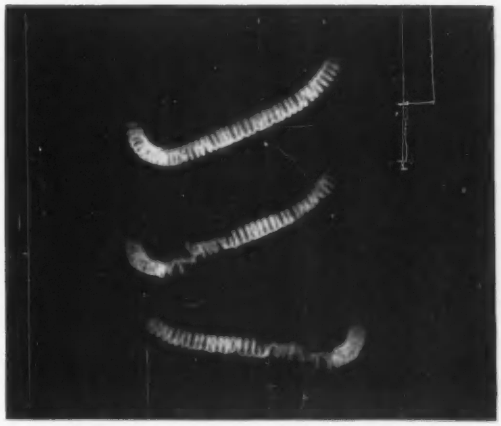
. . . is announced by General Electric. Developed specifically for air conditioning and refrigeration applications, the new insulating system uses an acrylic-resin magnet-wire enamel, a polyester film for phase and ground insulation, and polyester-fiber lead-cable insulation and sleeving. It is said to be "essentially moisture-free," to be capable of continuous operation at temperatures at least 35 F higher than are possible with present insulating materials, and to have a high degree of chemical stability. GE says the new system should "extend motor life, simplify the selection of motor-overload protection, and permit a somewhat greater freedom of refrigerant selection." Hermetic motors with the new insulation will be offered in both fractional and integral horsepower ratings.

### Foamed adhesives that can cut costs . . .

. . . as well as weight are ready to go to work, says James Zeigler of Arthur D. Little, Inc. Describing a new ADL foaming technique, he points out that foaming extends the volume of adhesives by 4 to 5 times, provides more uniform spread and a better bond, while reducing amount of adhesive needed. Though the technique was developed specifically for wood products, he says it can be applied to most types of adhesives (phenolic as well as urea), and that the foams have high initial strength and quick set, are water-resistant, and have good penetration. Importance of the development, if it can be successfully extended to metal, lies in the fact that even a thin glue line adds considerably to the weight of a structure. Ryan Aeronautical engineers point out, for instance, that, in corrugated-foil aircraft skins, the glue may weigh as much as the foil itself. A single glue line equals a sheet of aluminum 0.006 in. thick.

### New devices for accelerated testing . . .

. . . of resistors, diodes, and other electronic parts are being developed at Stanford Research Institute—with particular emphasis on nondestructive methods that will permit testing of very large numbers of parts. Pointing out that many present-day testing methods significantly reduce life of the part being tested, and may also give misleading information (photo, below left), SRI researchers are concentrating on *rate-of-change* techniques that will provide needed information in a very short test period. Typical of the equipment being developed is the lamp-tester pictured below, right.



**New electrical tests are needed** because present-day methods may give misleading results. Filament that breaks, as here, then rewelds, may pass test, but fail in service.

**Lamp-tester,** developed by SRI, measures rate-of-change in resistance, is designed to permit quick evaluation of lamp performance without markedly shortening its life.

# American...

*(continued)*

## DEVELOPMENTS TO WATCH...

### Liquid-cooled braking system . . . .

. . . cuts heat buildup by as much as 1500F on aircraft braking systems, says B. F. Goodrich. Developed under Air Force sponsorship, the new brake will get its first big tryout on the prototype Boeing 707. According to the Air Research & Development Command, "this is the first practical braking system for aircraft to use fluid for reducing excessive heat in the braking area." It's a disk-type brake that "removes heat from the critical wheel and brake area and carries it to a point where it can be dissipated at low temperatures." ARDC dubs it "revolutionary," and says it is "not simply a brake, but a completely new brake system that reduces high temperatures generated in aircraft landings." At present, the new brake weighs about the same as the standard type; but the ARDC expects weight savings through simplification of system components and changes in materials.

### Better capacitors, batteries . . .

. . . and magnetic storage devices are promised by the Atomic Energy Commission, as a result of unclassified contracts aimed at meeting the needs of such high-powered nuclear research devices as the 50-Mev MURA accelerator and the Stellarator C (*PE*—Nov. 4, '57, p. 12). Their input power requirements are measured in kilovolts, and the Stellarator at least will likely call for peak currents in the range of 200,000 amp. Most of the electrical-equipment research contracts are unclassified.

### Buyers are counting their pennies . . .

. . . and choosing lower and medium-priced models in place of souped-up gimmicks with all the extras. It's a trend, first noticed late last year, that's gaining strength. Several manufacturers who placed heavy emphasis on luxury lines during the past several years are now readying "basic" models that "cost less but do the same job." In tune with the times, automakers are emphasizing "fuel economy" instead of added horsepower. The $10,000 car also seems to be on its way out. Mail-order houses, which last year featured $100 sun dials, $25 automatic home shoe polishers, and $15 electric toothbrushes, are now showing regular clocks, hand-polishing shoe kits, and plain old-fashioned toothbrushes. It may be just temporary; but it's a trend that could possibly snowball.

### Distortion-free enlargements . . .

. . . with the qualities of silver-emulsion-paper reproductions; but at about one-fifth the cost, are promised by the new Helios Enlarger pictured here. Developed by Keuffel & Esser, it's to be introduced commercially later this year, with a letter-size model coming first, and larger sizes to follow. According to K&E, the combination of a new condenser-lens system and high-powered mercury-vapor light sources makes it possible to use low-cost diazo paper, and yet obtain satisfactory reproductions at a speed comparable to that obtained with silver-emulsion paper. —ARG

**New enlarger** has vacuum-type easel, mounted on twin rails, a helical lens mount, and special lens system; operates on conventional 110-115 v ac power. This prototype model handles letter-size sheets.

# GREX* in action

This amazingly sturdy face-guard turns aside the jarring crunch of a 200-pound fullback. It's made of plastic—new GREX high density polyethylene.

Toys take their share of slams, too, and industrial plastic moldings have to be tougher still. GREX plastic makes them that way: toys, trays, tubes or tools.

The impact resistance of this plastic mirrors its *other* strengths. Products made of GREX resist chemicals and acids, for example. They hold their shape when sterilized. They don't become brittle when frozen.

*This versatile plastic means better products for you.*

**Trademark for W. R. Grace & Co.'s polyolefins. W. R. Grace & Co. produces GREX resin for a wide variety of uses, does not make the finished articles mentioned above.*

**Introduction to the Laboratory**

Gleaming, chrome-faced cannonballs thud against a newly-molded plastic container. Objects whirl in the ultra-violet light of a test chamber. An endless strip of sandpaper rubs at the surface of a gear.

Here, in the laboratories of W. R. Grace's Polymer Chemicals Division, at Clifton, N. J., we pre-prove our product, GREX, for our customers.

**Condensing the Calendar**

In three weeks we can duplicate three years' exposure to sunlight, rain and freezing temperatures. A year's wear on a utensil is condensed into a week.

On the production floor, injection molding machines hum as we measure temperatures and pressures needed for GREX-molded radio housings. Sheet and film roll from extruders and are tested for uniformity and gloss. Nearby are facilities for compression molding, vacuum forming, blow molding, heat sealing and paper coating.

**Reports for Customers**

This unusual laboratory—actually a plant—creates nothing commercial, makes nothing for actual sale. Reports on its labors are given freely to GREX customers and prospective users.

These modern, complete facilities were built for the convenience of Polymer Chemicals customers. They function on your behalf—and can begin working on your problem immediately.

Simultaneously our Marketing Department can cooperate in helping you determine potentials and marketing methods, drawing upon the wide, varied experience of its personnel.

To learn more about GREX and the service it offers, *write today.*

W. R. GRACE & CO.
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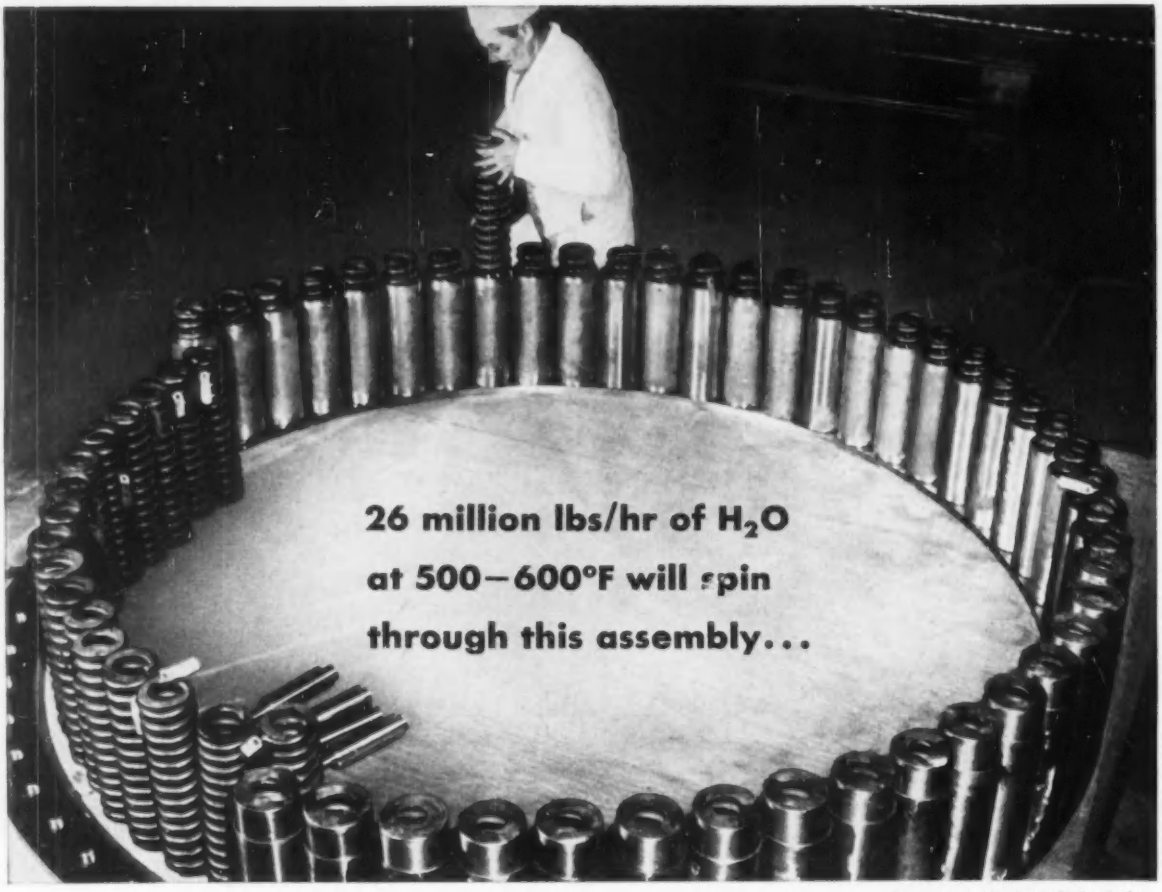
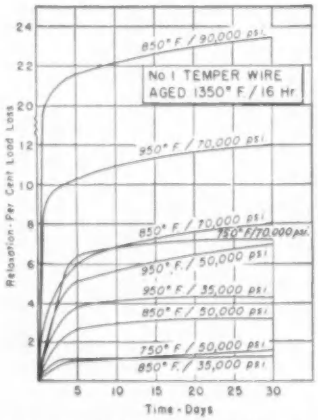



Photo courtesy of Combustion Engineering Inc.

# How Inconel "X" is used in Shippingport reactor to make sure core mount springs stand up

Superheated high-purity water makes many ordinary spring materials relax quickly. It may cause them to fail by stress-corrosion cracking or embrittlement.




Relaxation of Inconel "X" springs made from No. 1 temper wire.

An outstanding exception is Inconel "X"* age-hardenable nickel-chromium alloy. Springs of this alloy resist both corrosion and heat . . . up to 1100°F in certain applications.

Here are some relaxation curves, for example, which show what stresses Inconel "X" alloy is capable of handling at various temperature levels.

The curves speak for Inconel "X" alloy. When you want springs that resist relaxation at high temperatures this is the alloy to use . . . just as Combustion Engineering Inc. has done in spring mounting the core of this reactor, for a plant designed by Westinghouse Electric Corp. for operation by Duquesne Light Co.

### Inconel "X" gives you valuable bonus properties too

Inconel "X" alloy also offers you (1) excellent corrosion resistance (2) outstanding hardness and wear resistance (3) high fatigue strength (4) high tensile strength (5) low thermal expansion (6) resistance to stress-corrosion cracking.

Other Inco Nickel Alloys . . . more than fifty . . . offer designers other equally useful properties. Take Inconel 713-C*, for example, a new nickel-chromium cast alloy for 1700°F service. Or Duranickel* age-hardenable nickel with high strength and hardness. Properties of many of these alloys are summarized in the Inco booklet "Standard Alloys for Special Purposes." May we send you a copy?

*Trademark of The International Nickel Company, Inc.

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INCO

# INCO NICKEL ALLOYS

# American ...Washington

## DEVELOPMENTS TO WATCH...

### Civilian control of space experiments . . .

. . . looks likely. An inter-service fight is developing on the issue, with Army wanting to keep experiments under Pentagon jurisdiction but Air Force and Navy favoring civilian management. Both Air Force and Navy would be happy to have the National Advisory Committee for Aeronautics handle the job. The widely respected agency is presently headed by retired Air Force General James H. Doolittle.

At least one of the services—Navy—has told White House Science Adviser Dr. James R. Killian it favors NACA. Killian is sounding out the services before he makes his recommendations to the President on control of space experiments.

Another wrangle is developing among the services over who is to conduct space experiments. Air Force and Navy want to run the experiments and cut the Army in on information collected. Army, however, wants to collect its own data; it doesn't want to be cast in a secondary role.

All of the services have outer-space experimental programs they want to conduct. So far, however, the Pentagon's Advanced Research Projects Agency (ARPA) has not given any official go-ahead.

This decision is due by July 1.

Regardless of who—civilian or military—has the top voice in outer-space experiments, the military see a "serious conflict" over manpower cropping up. Within the next 10 years they say that space experimenters will be competing with weapon makers for scientific talent. Both fields need the same skills in electronics, metals, etc., with only a limited number of scientists and engineers available. This ties in somewhat with current conflict within each of the services over whether emphasis should be on missiles or guns.

### Small firms are shooting for missile work . . .

. . . through state delegations, which are beginning to trek to Washington to get their "fair share" of the government's upcoming missile-production contracts. Recently, a 25-man group from Minnesota called first on their Congressmen, then held briefing sessions with each of the military services.

They want the government to let them know about new projects so they can make a pitch for the business. Idea is to have some big company in the state get a prime contract, smaller local companies would then have a head start on subcontracting, making for a healthier situation all around. But the problem can't be resolved so easily.

The small companies—and even some large ones—complain that the government is negotiating its big missile-development programs without giving them a crack at the job. It is the old story of "need to know." It's hard for a company to dicker for a job it doesn't know about. But until a company becomes an active negotiator it doesn't "need to know."

### 150-man office to coordinate all Army research . . .

. . . from Ft. Belvoir, Va. In the past the Army has had no such central office. Each technical service—Ordnance, Signal, etc.—has handled its own research programs.

Under the new arrangement, a group of professional scientists will review programs before they are undertaken by the technical services. Contracts without side firms, however, will still be written by each of the technical services. The new 150-man office will not operate any of Army's labs.

### Basic research to get $30 million more . . .

. . . from Department of Defense soon. The agency is doling out $7.5 million to Army, $7.5 million to Air Force and $15 million to Navy for basic-research projects.

Primarily, the money will be used to finance university research experiments that the services want to sponsor but until now could not finance. The Army alone says it has 138 such proposals. These will cost around $4 million to support. The Navy and Air Force have even more. Right now, Navy spends around $50 million on basic research, Army and Air Force around $25 million each.

# World-wide ...

## DEVELOPMENTS TO WATCH...

### Solar energy to power machine tools? . . .

. . . Russian scientist Abram Ioffe says so. He foresees solar generators in which mirrors direct the heat of the sun's rays at thermal elements that will provide direct conversion of solar into electrical energy "to set small machine tools into motion" or power farm equipment.

"During the next few years," he predicts, "construction of transformers of solar energy into power will become economically profitable," so that it will no longer be necessary to build long power-transmission lines.

If this doesn't pan out, the Russians have another interesting power-source-of-the-future: The heat of the earth's core. Says Soviet geologist Dmitri Shcherbakov, "At a depth of 1500 ft one frequently comes upon superheated steam at great pressure and temperatures (300 F or more)." During the next 10 years, he predicts, "utilization of the internal heat of the earth will without doubt be of tremendous significance." Indeed, in some ways, he seems more hopeful about this as a major contribution to the world's power sources than about atomic fission or fusion. Other Russian scientists, too, seem as interested in solar energy as in the nuclear kind.

### Frost-warning device . . .

. . . for rail lines, airports, highways, and ships, is a combination thermostat and hydrostat, arranged to set off a visible or audible signal when atmospheric conditions indicate formation of sleet is imminent. Developed by Societe Jules Richard, Paris, it has already passed airport and highway tests, is now undergoing trials on aircraft carriers and railroad switching equipment.

### Transparent enamels for stainless steel . . .

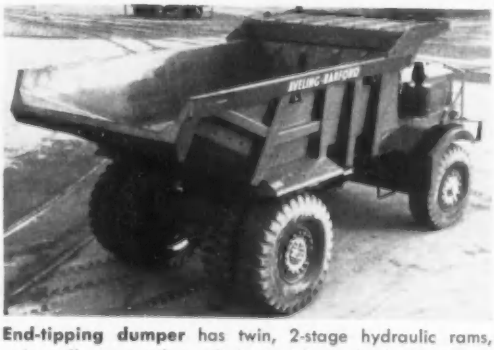
. . . and several new opaque types, are announced by A/S Cathrineholm of Halden, Norway. So far they've been used mainly on decorative pieces (in applications similar to those for enameled silver), but their acid resistance and ability to stand thermal shock should make them useful on appliances and other products. According to Cathrineholm, success of the new enamels is as much a function of processing technique as of formulation. "First-class steel, perfect sanding, and extremely careful workmanship" are recommended, and edges receive special treatment to assure good adhesion.

### Heading for the American market . . .

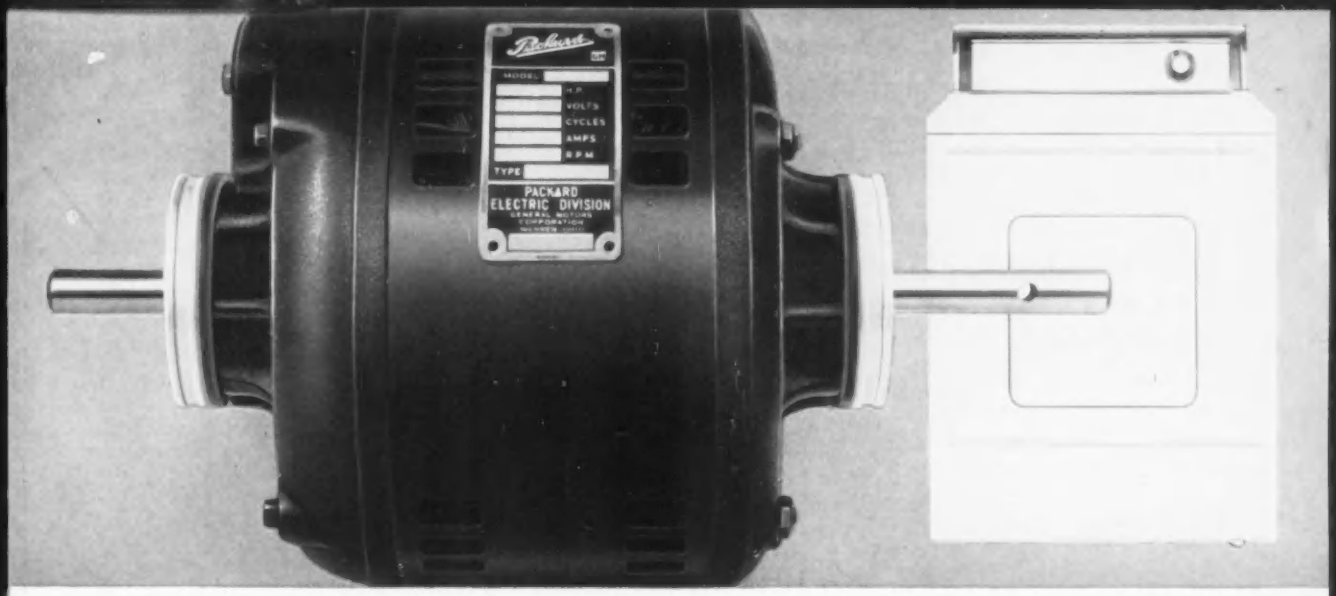
. . . and for overseas markets in competition with American products is "the largest dumper ever made in Britain." Designed by Aveling-Barford, Grantham, it's now undergoing final tests, has not yet been given a definite introduction date.

According to A-B, the dumper will carry 49 tons fully loaded, has a 333-bhp, 8-cyl, supercharged Rolls Royce diesel engine (British-built Cummins also available). Six forward and one reverse gear, controlled by a single handlever, will go 3 to 30 mph without double shift.

To reduce shock loads on the transmission, flexible couplings are provided between engine and gearbox and gearbox and rear axle. An automatic transmission with torque converter will be available as optional equipment.




**End-tipping dumper** has twin, 2-stage hydraulic rams, universally mounted, to eliminate side strain during operation on uneven ground. Made by Aveling-Barford, it also has leaf springs, hydraulic shock absorbers.




**DEVELOPED** / *A new Packard Electric motor*

**FOR** / *A better clothes dryer*

Custom-tailored electric motors for mass-production products—they're Packard Electric's stock in trade and many an appliance maker has profited in the bargain.

Because Packard motors are *designed* for rather than adapted to their jobs—they always provide just the right kind of power. Often they also open ways to make products look better, work better, and cost less.

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# What's happening in SCIENCE

## Our moon won't be first stop, says Columbia scientist

We'll likely be landing on one of the moons of Mars before we land on our own, predicts Dr. Jan Schilt of Columbia U. It's a matter of gravity (see below) and atmospheres.

Although our moon is smaller and has a lesser gravitational force than Earth, it's still pretty big, and the atmosphere is thinner. Result: It would take even more braking power to land safely on the moon than it would on Earth. Take-off would require a lot of power and fuel, too.

"In contrast," he says, "the far-off moons of Mars are so small (5 to 10 mi in dia.) they could be as easily tagged and tied up to as hitching post. They would have negligible gravitational attraction for the spaceship," and so would pose none of the takeoff problems a larger moon would.

How long would it take to get to the planet Mars? About six months, he estimates, at reasonably achieveable takeoff speeds. (It's about 35 million mi away.)

When will the trip be made? Before the end of the century, he believes, noting that "actual plans for travel to one of the moons of Mars depend on technical solutions to several practical problems, all of which have been at least started on." A trip to Earth's moon is a lot farther off, he thinks. "We shall have to wait considerably longer before reaching even the blueprint stage."

It should be noted, of course, that a real breakthrough on the gravity problem—discovery of a way to negate or screen off the force of gravity (*PE*—Dec. 30, '57, p. 12 and photo below)—could change the picture a lot. On this score, the most recent report of the Gravity Research Foundation says:

"The only experiment that appears to hold promise of producing a variation in the gravitational field of the earth," is one in which some 60 alnico magnets, set between two steel disks about 15 in. in dia., are inserted in a pit and rotated at 2400 rpm. While they are rotating, a small but significant deflection has been noticed on a Carter gravimeter—a variation that does not seem to be traceable to eddy currents, magnetic effects, or other obvious explanations. Strangely, the experiments seem to work best when the rotor is surrounded by some massive material, as it would in a cement or slate pit.

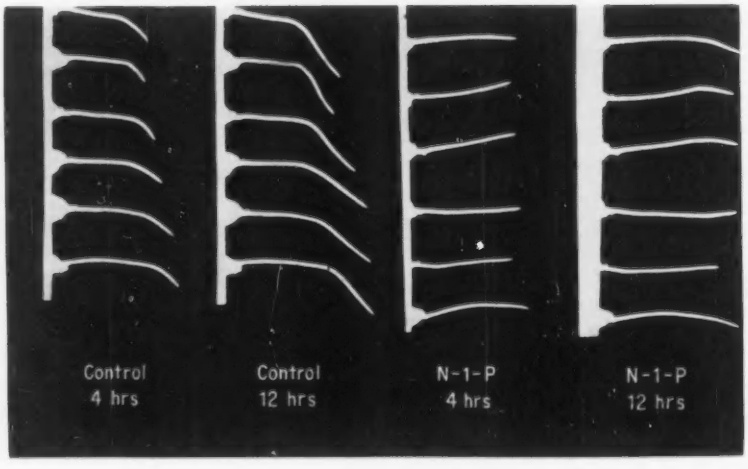
## Six ways to pour on the heat

As new metals call for higher processing temperatures, aircraft fly faster, and industrial technology in general moves into a higher heat range, provision of high temperatures for material and component testing becomes a major problem in many labs. A review, then, of laboratory methods for achieving high temperatures seems in order, and Battelle Memorial Institute has done just that, coming up with half a dozen that seem especially promising. Here they are, arranged in order of top temperature so far reached: (It should be noted that the temperature given in parentheses is not necessarily the top theoretical limit; but only the level so far achieved.)

1. Quartz lamps (2500 F)
2. Heated wind tunnels (4000 F—Mach 10-15)
3. Solar furnaces (6000 F)
4. Rocket motors (5000 to 8500 F.—*PE*—Dec. 30, '57, p. 12 and Jan. 6, '58, p. 56)
5. Electric arcs (10,000 F)
6. Plasma jets (20,000 F—*PE*—Feb. 24, '58, p. 14)

Each of these, of course, has limitations as well as advantages. Both the rocket motor and the solar furnace, for instance, offer high heating rates (300 Btu/ft² for the rocket, and 2000 for the solar furnace), but specimen size is, at present, limited in most cases. Electric arcs offer very high temperatures, but gas velocity is low and the chemistry of the system is quite different from that of air. The same is true of plasma jets and rockets.

For the future, Battelle scientists foresee use of nuclear-particle accelerators and perhaps even controlled nuclear blasts as a means of testing materials under both heat and aerodynamic conditions. Meanwhile, a great deal can be learned by judicious application of these. —ARG




**Will plants point the way** to control of gravity? The National Science Foundation says the sensory mechanism for gravity detection in plants "may be analogous to the *solion* device developed for missile guidance." Scientists at Michigan State have found that treating corn rootlets with naphthylphthalamic acid seems to destroy their geotropic sensitivity, so they grow every which-way (right), instead of in the normal manner (left).

# You Cut Costs with Aeroquip 2802 Hose (Teflon*) Because "*super gem*" Fittings are Reusable!

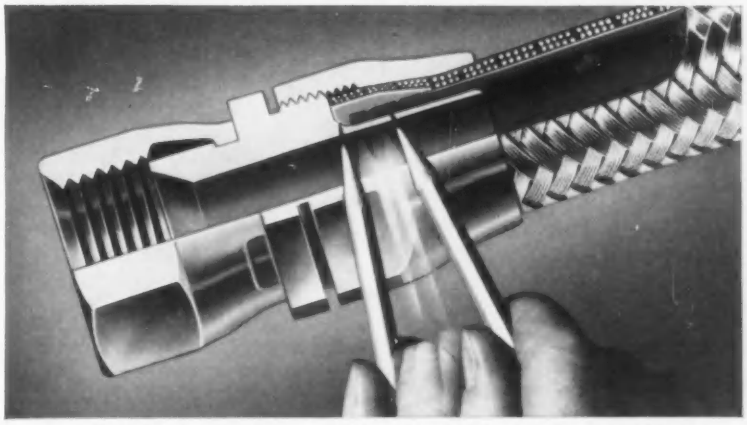
**PROLONG LIFE OF FLUID SYSTEMS SUBJECT TO HIGH TEMPERATURES, CORROSIVE CHEMICALS**

Hose lines of Teflon give unequalled performance wherever extreme fluid temperatures are encountered, or where chemical stability, lubricity, flexing and long service of the hose are critical factors.

In selecting a hose line of Teflon, important advantages can be gained by giving consideration to the type of fitting used with the hose. For best results, it must be designed to (1) give leakproof performance in prolonged operation and (2) permit disassembly and reuse of the entire fitting.

*Only the Aeroquip "super gem" Fitting meets both of these requirements.*

The need for a permanently leakproof fitting is obvious in conveying such fluids as live steam and strong acids and bases. How the "*super gem*" Fitting is designed to give double protection against leakage is shown in the illustration at the right.



Cutaway of a "*super gem*" Fitting, with line seal pointed out at left and lip seal at right. Together they furnish permanent protection against leakage. Note how fitting grips only the wire cover, preventing cold flow of the inner tube of Teflon.

### REUSABLE FITTINGS CUT COSTS

Due to the relatively higher cost of hose lines of Teflon, the fitting that can be completely salvaged and reused offers substantial savings in cost. The Aeroquip "*super gem*" Fitting can be assembled and disassembled on hose line of Teflon quickly using ordinary bench tools. No expensive swaging machines are required. This permits quick engineering mock-ups and modifications.

In the typical hose assembly of Teflon shown at the left, the fittings account for 54% of the total cost. On the production line or in final use, the entire hose line of Teflon need not be scrapped if an alteration is made involving these fluid lines. In all cases, Aeroquip "*super gem*" Fittings can be disassembled and salvaged completely.

### WIDE RANGE OF FITTING SIZES AND MATERIALS

Aeroquip 2802 Hose of Teflon is available in sizes from ¼" to 1¼". "*super gem*" Fittings are available in aluminum alloy, stainless or carbon steel. Male pipe fittings are available in carbon steel only.

Full information on Aeroquip 2802 Hose of Teflon and reusable "*super gem*" Fittings is available. Fill in and mail the coupon below for engineering bulletin IEB-26A.

Complete engineering assistance is available to manufacturers.

**SEE OUR CATALOG PAGES IN SWEET'S PRODUCTS DESIGN FILE, SECTION 6D.**

**SPECIFICATIONS—AEROQUIP 2802 HOSE**

| DASH SIZE | −4 | −5 | −6 | −8 | −10 | −12 | −16 | −20 |
|---|---|---|---|---|---|---|---|---|
| O.D. Tube Size | ¼ | 5/16 | ⅜ | ½ | ⅝ | ¾ | 1 | 1¼ |
| Hose I.D. | 5/16 | ¼ | 5/16 | 13/32 | ½ | ⅝ | ⅞ | 1⅛ |
| Hose O.D. | 5/8 | ⅜ | 7/16 | 17/32 | 21/32 | 25/32 | 1 1/32 | 1 19/64 |
| Max. working psi. | 2000 | 2000 | 1750 | 1500 | 1500 | 1250 | 1000 | 700 |
| Min. burst psi. | 12000 | 10000 | 9000 | 8000 | 7000 | 6000 | 4000 | 2800 |
| Min. bend radii | 2 | 3 | 4 | 4⅛ | 5½ | 6½ | 8 | 16 |
| Wt./ft. (lbs.) | .084 | .093 | .118 | .146 | .205 | .240 | .338 | .406 |

All dimensions in inches.

*DuPont trade name for its tetrafluoroethylene resin.
"*super gem*" is an Aeroquip Trademark.

Aeroquip Corporation
Jackson, Michigan

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# What's happening in MATERIALS

## Separating the inseparable

Some metals and metallic compounds go together too well. Hafnium and zirconium, for example, are so similar chemically that it's almost impossible to get them apart by ordinary chemical processes. The rare earths, too, tend to cling together.

Why not leave them that way?

Though their chemical properties are similar, nuclear and sometimes electrical, properties are not. Hafnium, for instance slows down nuclear reactions, while zirconium does little to interfere.

Right now, several promising separation techniques are under study—some based on ion exchange; others on solvent extraction. One of the most interesting is a special form of "solvent" extraction—using molten magnesium metal as the "solvent." As researchers at Ames Laboratory, Iowa State College, point out, one of the big advantages of this technique is that metals can be handled in metallic form. They don't have to be converted into chemical compounds for extraction and then back again.

This technique, and other new separation processes, are far from "commercial." But, as our atomic-energy program grows, demand for such techniques—and the supply of separated metals—is likely to grow with it. (For information on the current status of our atomic-energy program, see *PE*—Apr. 14, '58; and for detailed data on hafnium, and other newly available metals, see Mar. 17 '58.)

## New laminating film coming up

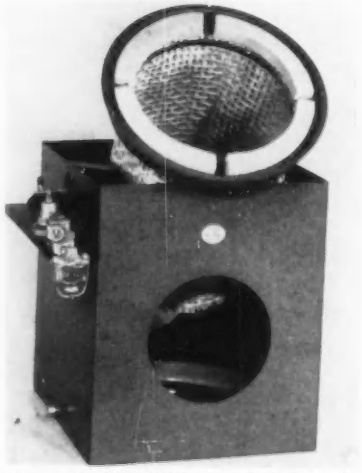
A "completely new" polyester film that will adhere (under heat and pressure) to metals, glass, fabrics, wood, and electrical-grade papers—and a brand new plant to make it—are announced by Goodyear.

To be called *Videne* A, the film is said to have unusual abrasion resistance, ability to withstand outdoor aging, and desirable electrical properties. Unlike most polyesters, it's a thermoplastic material, can be vacuum-formed as well as laminated.

Goodyear is now selling the material in limited quantities, expects to have its full-scale plant in production by 1959, turning out this type of film and at least one other, specifically designed for packaging.

## Woven foam for warm-air humidifier

A novel approach to the problem of moisture control in warm-air heating systems is the basket pictured here. It's made of interwoven strips of cellulose sponge—the same type of material used in household mops, scouring pads, and the like. According to duPont, which makes the sponge, the basket will absorb up to 20 times its weight in water, give it up as needed to heated air as it passes through. Water is fed in through circular aluminum trough at the top. Then, as the air passes through, it absorbs moisture, raising the relative humidity to the desired level. The unit has a solenoid valve and pressure regulator (mounted at the left in the one pictured below), and may be controlled by a room humidistat.



**Warm-air humidifier** is designed for placement in air duct leading from furnace. Air Heet Corp. makes it, also uses foam in hot-water and steam units.

## Textiles: How much does a car use?

Despite all the talk of plastic headlinings and upholstery, the standard passenger car today still uses plenty of textile fibers, and not just in the tires, C. A. Chayne, GM vice president in charge of Engineering Staff, reports. As a matter of fact plastics accounted for less than 1% of total car weight last year; while the textile percentage was more than twice as high. Use of plastics is increasing rapidly though—notably in mechanical parts. Butyrates and propionates, for instance, are used for moldings, control knobs, and dial pointers; phenolics for insulation, connectors, and clutch facings; nylon for bushings, gears, fuse holders, insulators, carburetor parts and valve caps.

## briefs . . .

**Columbium** gets another new producer: U. S. Industrial Chemicals. It's now building a ton-a-day columbium-tantalum pilot plant to test out a new sodium-reduction process, originally developed for titanium and zirconium; plans full-scale production (probably in conjunction with Mallory-Sharon Metals) if the process and market research studies prove out. (To find out why this metal is sparking so much interest, and how it can be put to work, see March 17 issue of PE.)

**Lighter, stronger** light-metal alloys (and perhaps other types as well) are expected to come from a new, joint research effort by Lithium Corp. of America and Brooks & Perkins, Inc. Lithium has already been shown to increase the toughness and heat resistance of aluminum (*PE*—Nov. 11, '57, p. 8), and it can be a major factor in weight reduction.

**Linear polyethylene film** said to have good clarity and high strength is being produced by a new process developed at Phillips Chemical Co. Phillips plans to license the technique, expects the film to compete with cellophane and cellulose acetate in cost as well as appearance. —ARG

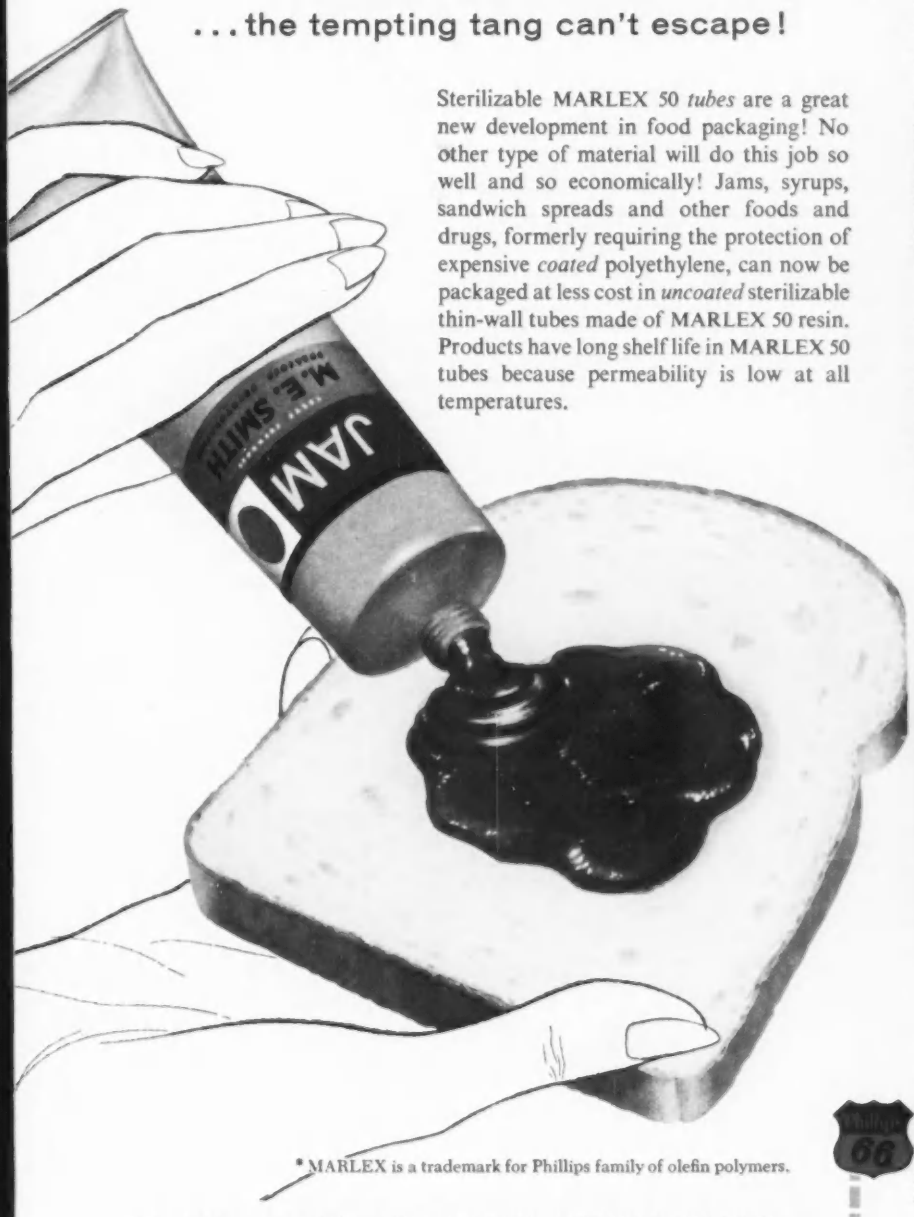
# Jam-Packed with Flavor!

because it's packed in

# MARLEX* 50

## POLYETHYLENE

...the tempting tang can't escape!




Sterilizable MARLEX 50 *tubes* are a great new development in food packaging! No other type of material will do this job so well and so economically! Jams, syrups, sandwich spreads and other foods and drugs, formerly requiring the protection of expensive *coated* polyethylene, can now be packaged at less cost in *uncoated* sterilizable thin-wall tubes made of MARLEX 50 resin. Products have long shelf life in MARLEX 50 tubes because permeability is low at all temperatures.

**"Heat'n serve"** frozen food packaging is one of the most promising applications for film extruded from MARLEX 50. Flavor is sealed in, and the housewife has no pans to wash!

**Chemicals, foods and drugs** that would show extensive permeation with conventional polyethylene now can be economically shipped in drums or cartons lined with tougher, more impermeable MARLEX 50 polyethylene.

**Marlex 50** food packaging has outstanding resistance to attack and permeation by moisture vapor, gases, chemicals and oils. Containers made of heat and cold-resistant MARLEX 50 can be steam-sterilized prior to filling...and frozen afterwards if required.

*MARLEX is a trademark for Phillips family of olefin polymers.

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Titanium's corrosion resistance and low heat conductivity team up to...

# DOUBLE SOLDERING PRODUCTION

**All-titanium** *dip soldering jig developed and used by Astatic Corporation has advantage of low heat conductivity and corrosion resistance.*

**Titanium** *jig has excellent wear resistance, permits holding close tolerances when soldering phonograph needle assembly.*

In handling a variety of soldering operations on small precision parts, Astatic Corporation—electronics manufacturer—has realized many benefits with Mallory-Sharon commercially pure titanium soldering fixtures:

- Corrosion resistance of the titanium fixtures to certain soldering fluxes is excellent. Thus service life is far longer than that of other metals previously used.
- Heat conductivity of titanium is low. Thus the fixture does not take heat away from the work, and the operation takes less time. On a typical assembly, use of the titanium fixture increased daily output from 1000 to 2500 parts per day.
- Titanium's excellent wear resistance, plus the fact that solder does not stick to titanium, allows very close tolerances to be maintained. Assembly rejects were cut from 25% to less than 1%.

Can *you* use titanium's unique advantages? For information on properties and fabrication techniques ask for the booklet "Titanium Fact File". Write Mallory-Sharon Metals Corporation, Niles, Ohio. Mallory-Sharon produces titanium, zirconium, and other special metals in sheet, strip, rod, bar, plate and other standard shapes to meet your requirements.

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# LONGER SOLENOID LIFE...

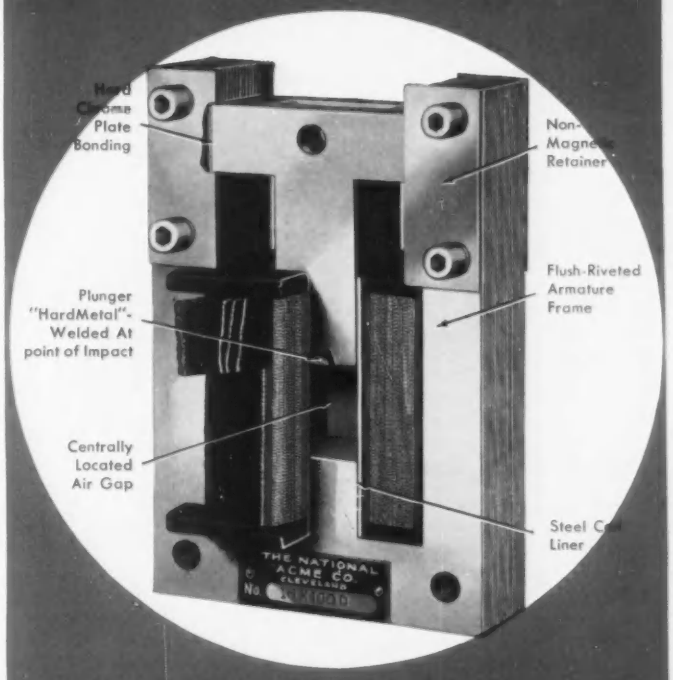
## with NAMCO'S exclusive "HARDMETAL"-welded plunger bonding

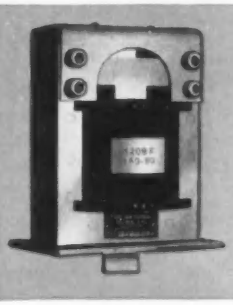
### Standard or Custom Models To Fit Your Design

"HardMetal"-welded plunger bonding prevents mushrooming at the vital point of impact—withstands incessant pounding of the plunger on the frame. Long plunger life, and thus long solenoid life, is further insured by hard chrome plating upper guide edges of plunger laminations to reduce friction and wear.

Namco standard solenoids are available in six series of pull and push types; custom-engineered solenoids in every size and type can be made to meet your specifications.

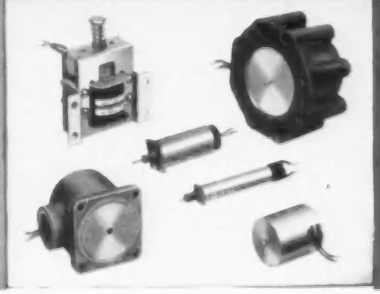
**Standard "HardMetal"-Welded Solenoids are furnished push or pull type in sizes with ratings from 2-1/2 to 21 pounds at 1/2" stroke and from 2 to 25 pounds at 1" stroke.**



← Saddle stop applied to Series K200 standard Namco push type solenoid.

To meet specific job requirements, solenoids of special shapes and sizes are designed and built through cooperation of our engineers with yours. →



Ask us to send a National Acme Representative to discuss your problems, or if you want more information first—send for BULLETIN EM-52.

ELECTRICAL MANUFACTURING DIVISION

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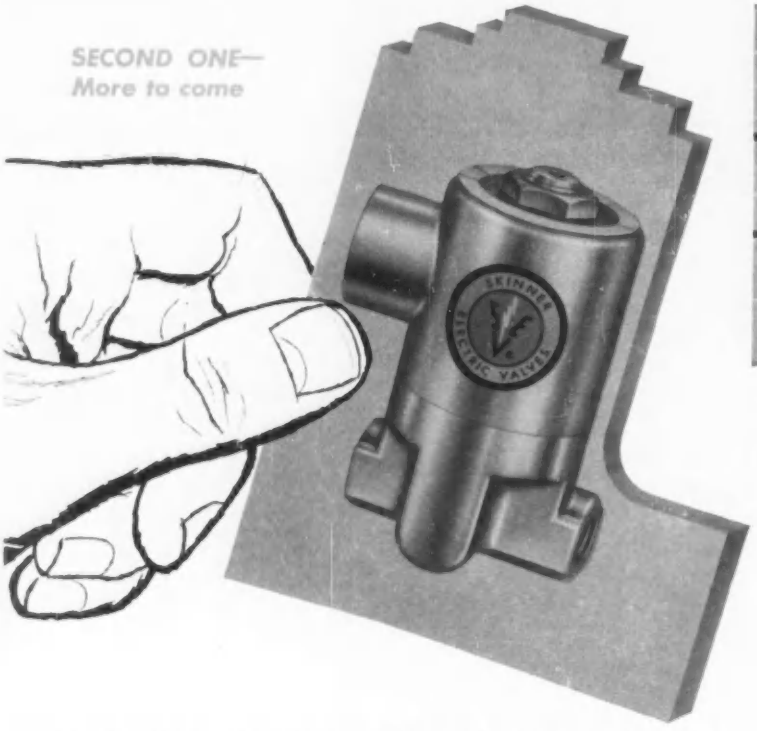
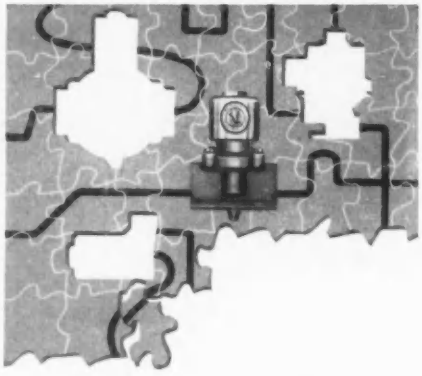
More to come



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SKINNER'S NEW 2-WAY VALVE OFFERS

# big capacity — high pressure

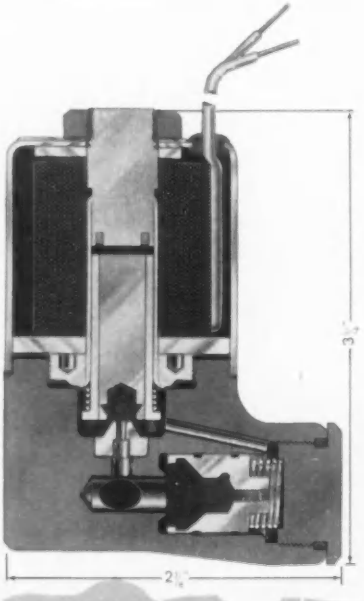
Here's the second new line of valves designed to answer your control "puzzles." This new line, called the R Series, is a two-way, pilot-operated piston valve with ¼" orifice and ¼" NPT. It is available normally open or normally closed and operates on a pressure differential of 5 to 200 PSI. This new R Series also includes an Explosionproof line in normally open and normally closed construction. A normally closed version will be available soon to operate on pressures up to 1000 PSI.

This new R Series uses the famous Skinner V5 Operator and will control air, water, oil and semi-corrosive media. The normally open version can, on request, be supplied with pilot exhaust piped to body outlet port.

A wide selection of coils—high-temperature, waterproof and standard—for common AC and DC voltages is available, and there is choice of electrical connections such as Automotive Terminals, Grommet and Conduit.

The temperature range of this new line is −65° to 180°F Ambient, and −65° to 150°F Media. It is light in weight—only 1¼ pounds—and can be mounted directly to the line by means of the ¼" NPT. Distance between ports is 2 inches.

For complete information about this new line of Skinner valves, please contact our Representative or Distributor near you—you'll find him listed in the Yellow Pages. Or write us at the address below, Dept. 453.




SKINNER ELECTRIC VALVES
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SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
105 EDGEWOOD AVENUE

# MAN IS A PRODUCT TOO

Specialists and managers in industry have "jus' growed up," like Topsy—until recently. Now there is increasing evidence that the man with special abilities must be singled out and built, and that special abilities in on area shouldn't be assumed to be special abilities in all.

Tradition had it that the "boss"—disregarding by intent those who inherit their jobs—attained his status either by seniority or by competence. Thus the shop foreman was the best mechanic, the chief engineer was the best designer, the sales manager was the best salesman, and so on. He theoretically held control of his staff because he knew more about the job than they. He could do anything they could do, but do it better. Whether or not he could manage people seemed immaterial. As a result, many bosses had little or no managerial ability.

Likewise with the specialist. The man who showed a marked ability in some direction was shoved still further in that direction. He did all the jobs of a particular type. No one else was given a chance to learn. He built his own little empire of job security, was isolated in a corner, and had no opportunities for advancement because he "couldn't be replaced."

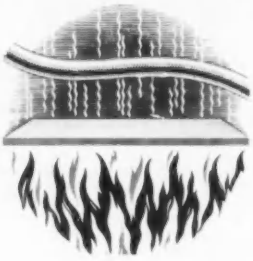
The past quarter century has brought changes in this, as it has in so many other things. We now have some understanding of management, of how to handle people. As a result, the manager is frequently selected for his ability to manage, without much consideration of his technical skill or seniority. People work *with* him, not *for* him. He is trained in management technique, just as a craftsman is trained in technical skills, by in-plant or outside courses. He may be sent to a special graduate school. Or the large company may start its own school, as General Electric did at Crotonville, NY, several years ago.

The product of such training is a manager, skilled in administration and in handling people, but frequently with little special knowledge of the techniques. The system works, but it works because there has been a corresponding change in the role of the specialist. He is no longer fenced in; he is brought out as a skilled man, likewise sent for special training, and paid accordingly—more than the manager in some cases. He may act as consultant for other groups as well, but this job does not require him to enter management in order to "get ahead." And he doesn't have to protect his job—he can train others.

This procedure, formal or informal, can do much to help the little company as well as the large. It recognizes the specialist, but frees him from management, which he frequently detests. Yet it provides management, too, without which no company can prosper. And it classifies management as a type of work, rather than a skill God-given to those who "get ahead." In simple terms, it recognizes men as products, too—products of thoughtful design.

K. S. Vangerman

If your
HOSE LINES
must cope with
these conditions...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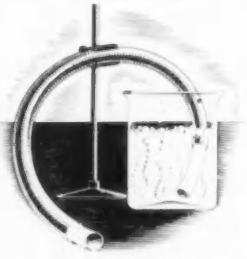
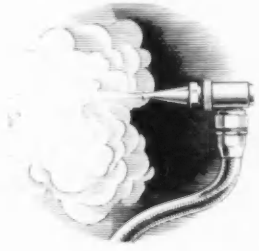

CORROSIVE CHEMICALS

ADHESIVES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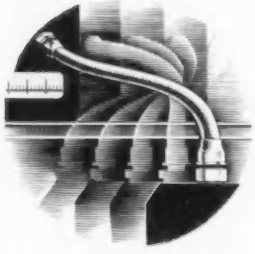
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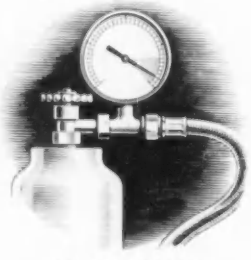
HIGH PRESSURES

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Hose lined with TEFLON TFE-fluorocarbon resin is being specified for the toughest jobs, *because:* TFE resins are unaffected by practically all corrosive chemicals and solvents. They can take continuous operating temperatures up to 500°F. . . . remain tough and flexible in extreme cold. They have excellent endurance under severe conditions of impulsing and vibration. Handle live steam without failure. Repel adhesion of sticky or viscous substances . . . reduce possibility of contamination. Available with either permanent or reusable couplings.

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*TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed here.*

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# Rocket Fuels: Solid or Liquid?

The big discussion among the experts in missiles now is fuel: will it be liquid or solid. The missiles getting most of the headlines are the ICBMs, the satellite launchers, and to some extent a few of the IRBMs. Liquid fuel seems to have a corner on this market, while the solid fuels have been used mostly with the smaller Army tactical missile, a short-range surface-to-surface vehicle, and the Air Force's air-to-air missiles.

But top military officials say that the next family of missiles will be solid fueled. Navy's 1500-mile Polaris is the immediate hope. And coming along is the Army's 500-mile Pershing solid-fueled missile that may eventually replace the liquid-fueled Redstone. Redstone was the first stage of the Jupiter-C, that launched the Explorer satellite. The Air Force is on the verge of testing the biggest solid-fueled engine to date. Reportedly, it will be used to power an airborne IRBM.

### SOLID FUELS

These fuels are divided into two basic types: the double-base; and the composite.

Double-base fuels are homogenous mixtures of nitrocellulose and nitroglycerine with small amounts of additives mixed in for stabilization and ballistic control. The stabilizer additives are used to give storage life to the propellants—estimated at several years—and to prevent the fuel from decomposing and igniting through spontaneous combustion.

The additives for ballistic control—burning rate—vary according to the military characteristics desired. But so far, the military won't identify the additives.

The composite solid fuels generally are described as heterogenous fuels consisting of a crystalline oxidizer uniformly dispersed in a plastic binder. The composite propellants also have additives for stabilization and ballistic control.

Many oxidizers and binders are used in the composite propellants. Some oxidizers are ammonium nitrate, sodium nitrate, ammonia perchlorate and other synthetic rubbers, polyester resins and polyvinylchloride.

### DOUBLE-BASE VS. COMPOSITE

The which-is-best debate is still going on. Fuel type depends on the missile and what it is supposed to do. The double-base propellants, which are actually an outgrowth of black and smokeless gunpowder and the JATO units used during World War II, are best for small battlefield rockets like the Army's Bazooka. The composite fuels are considered best for the bigger weapons—IRBM-size.

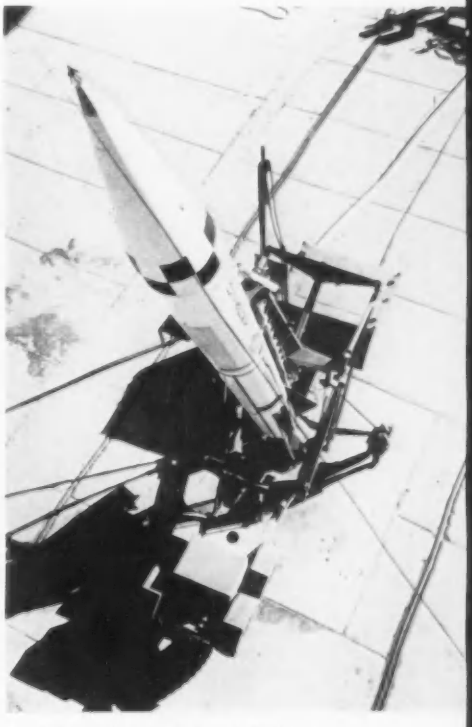
An advantage of the double-base fuels for tactical weapons is that they don't produce much smoke or fumes when fired. Smoke would help the enemy spot launching bases. But the burning rate of the double-base fuel is more sensitive to variations in temperature and pressure than are the composite fuels.

Generally, the composite fuels are more refined; they are an outgrowth of the double-base fuels. The more flexible composites permit designed-in performance. The Navy's Polaris IRBM uses a composite solid fuel. So will the Army's new 500-mi Pershing. Both missiles bear out the argument for composite fuels in the longer-range weapon.

The two types of solid fuels are packaged differently. The double-base fuel has its own container and is placed in rocket engines cartridge-style, in steel, aluminum, or plastic containers. The composite fuel, how-

**Two rocket designs, two fuel concepts . . .**

The Army's Sergeant (above) is a tactical, ballistic, guided missile using a solid rocket fuel to lift its 30-ft body. (Modified Sergeants made up the last two stages . .



. . of the rocket that carried Explorer into orbit.) Atlas ICBM (above) uses liquid propellents. Each fuel has its advantages and disadvantages. Liquid propellents can be controlled more precisely, but they are dangerous to handle and store.

ever, is cast in the engine and becomes a part of it.

Both fuels are ignited the same way. Usually this is done from the top of the fuel. A small charge of gunpowder is electrically ignited. Flame spews down the entire internal length of the fuel to ignite all sections and give even burnout. The hollow internal configuration of the fuel's core is varied in its design to govern how fast the fuel is to burn. For example: serrations permit more area to burn at once, and for quick burn out.

Until recently the big problem in working with solid fuel was in controlling burnout time. With the big IRBM and ICBMs, this has to be accurate to the second. But, the experts claim this problem has been solved. And, they say solid and liquid fuels provide about the same thrust.

#### NEW LIQUID-FUEL DEVELOPMENTS

While the solid fuels seem to be the coming propellants for missiles, some experts warn against ruling out liquids for the future. They claim that the liquid-fuel producers have not been progressive enough in their experiments. In effect, they have let themselves be outsold by the solid-fuel exponents. And, it's possible they say—without giving details—to produce liquid fuels with more thrust than solid fuels can develop. Also, they think that liquid fuels can eventually be packaged and stored about as conveniently as solid fuels.

As this group sees the picture, solid fuel may grab off the job of pushing the missiles around, but when it comes to space flight and moon landings, new versions of liquid fuels will be the propellants. The weight factor will be the key point they say, and liquids can do the job lighter.

Relative safety of liquid and solid fuels is also debatable. This also holds for the two types of solids—all of the fuels are dangerous unless properly treated and handled. Liquids are highly corrosive and present loading problems that would become more acute under wartime conditions when speed would be the factor. Also, with fuels used now, if the missile is not fired the fuels must be drained.

Solid fuels don't have this problem. There is the normal explosive danger, however, in the original mixing and preparing. Solid fuels don't have toxic effects of some of the liquid fuels. The experts won't be pinned down to which of the fuels is safest.

#### SOLIDS MOST CONVENIENT

There is no question however about solid fuels being the most convenient to work with. And, missiles designed for solid fuels do not require the elaborate plumbing necessary for liquid fuels. Each part added to a missile increases its chance of failure.

## Canada Close to Pollution Control

MONTREAL—Streams and lakes polluted by sewage and industrial wastes may soon be cleaned up by a process now in final stages of development.

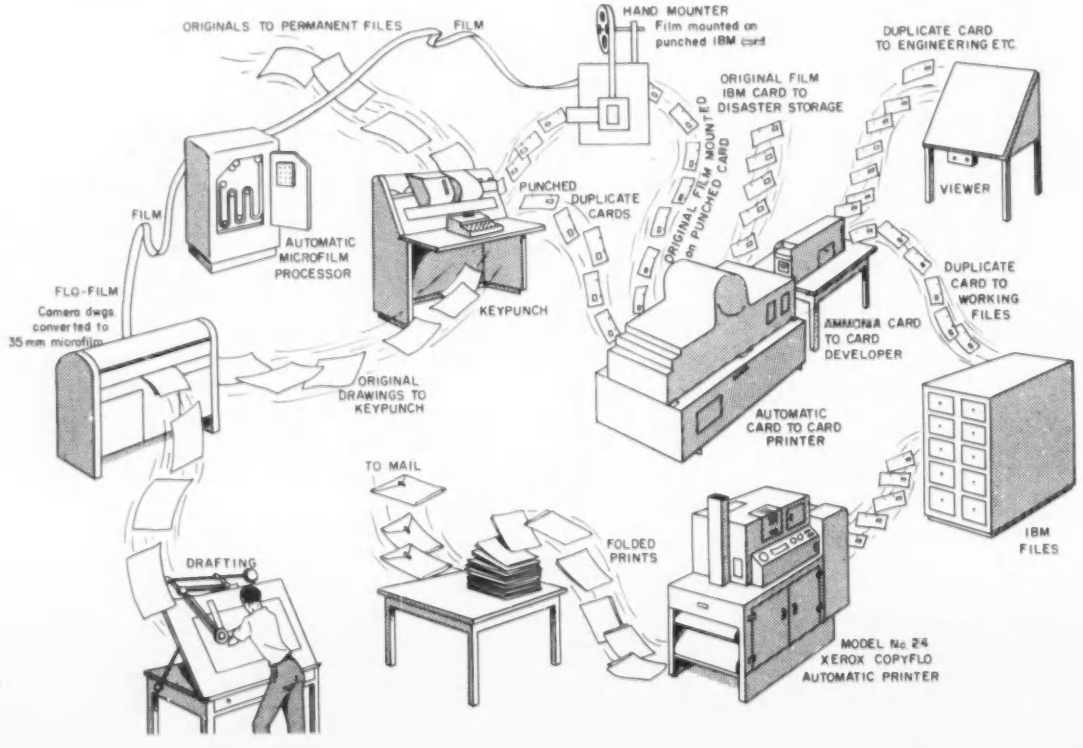
The Pulp and Paper Research Institute of Canada is removing poisonous chemicals from water by breaking the polluted water into a fine spray, then heating and whirling it. (See "U.S. Invests Heavily in Fresh Water," Oct. 7, '57, p. 23.)

When the process is proved commercially it may be used for: extracting fresh water from sea water on a large scale, sanitary disposal of sewage, refining oil and metal ores, and separating the waste products of many industries into usable chemicals and pure water.

The solids can be separated after the liquid has been atomized by a cyclone separator. "Then the stream can be passed along as process steam in the plant, or condensed and the water re-used.

With paper-mill waste, combustible gases are drawn off with the chemicals to be saved, and are passed back into the outside jacket for burning to keep the process going.

The Institute's Montreal pilot plant converts liquids by the gallon; commercial plants would process "hundreds of tons a day."



# Hydraulic, Pneumatic—Too Many Systems in One Car

DETROIT—A number of different solutions are now being investigated to replace the multiplicity of auxiliary power systems used in the late model cars. Automobiles now have an electrical system, one or two hydraulic systems and a pneumatic system, the latter for the new air springs. This occupies too much space in the shrinking under-the-hood compartment, is uneconomical, and helps to weigh down the already overloaded front end of the car.

The new system may be on cars three or four years from now. Generally these will merge all the fluid systems (hydraulic and pneumatic) into one. The electrical system would remain.

#### THIS IS ALL

All pneumatic: This is a definite possibility, will be influenced by public acceptance of the airspring, and the operating trouble connected with it. If this system is adopted, it would mean air brakes and pneumatically operated power steering. The difficulty is in converting hydraulic drives to pneumatic. While this is not unsuperable, there is the added fact that some automobile manufacturers are not altogether happy with the air spring, primarily because of difficulty in controlling leakage over long inactive periods.

All hydraulic: An all-hydraulic spring for automobiles has been developed and is being marketed by an independent concern. It has a manual control on the dashboard for controlling spring rate. Other hydraulic springs are in various stages of development. Advantage of the hydraulic system is greater compactness, greater ease in preventing leaks. But it may cost a little more and does not have the softness of air. The last obstacle is not critical: a dead air space above the fluid in the spring would give the springing advantages of air, the ease of control of hydraulic.

## Develop X-ray Inspection for Solid Fuel

BURLINGTON, MASS. — A new technique for X-ray inspection of solid rocket and missile fuel charges, surpassing efficiency of existing methods, has been announced by High Voltage Engineering Corp.

One of these supervoltage X-ray generators is the heart of the system developed jointly by High Voltage, Thiokol Chemical and the Friez Instrument Div. of Bendix Aviation.

Thiokol found that internal cavities, cracks, fissures or bits of foreign material can affect performance of missiles by upsetting a critical predetermined balance ratio between the missile charge and the centerline of the missile.

#### CAVITIES CREATE HAVOC

As the combustion line advances along the propellent charge surface, hidden pockets or cavities can cause uneven burning. This sometimes affects forward thrust, altering the missile's course; sometimes a hole is burned through the missile's side, causing destruction.

Inspection of solid propellants to date has been costly and cumbersome. Radiographic film is wrapped around the missile's outer surface, or arranged in a flat plane. X-rays are passed diametrically through the fuel to expose the film. But this technique is limited because the X-rays lose much intensity as they pass through the entire thickness of the missile before exposing the film. First installation of the system is slated soon at Marshall, Tex.

### Dial a Drawing

Dial a code number into phone and receive up-to-date print of desired drawing —that's the goal of GE's mechanized print-handling system at its Lynn, Mass., plant. Drawings are converted to microfilm negatives (1500/hr) mounted on IBM cards for compact filing and automatic identification. System, being carefully watched by other GE plants, may be expanded for TV viewing at production stations and cross-country wire-photo service.

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## Bits and Pieces

The expansion of the Army's guided missile and rocket weapons program, perhaps as a direct result of that service's success with the Explorer satellite, has created a need for scientists and engineers of almost all types. The Redstone Arsenal at Huntsville, Ala., has openings with salaries from $4480 to $12,690. For information write the U.S. Civil Service Commission, Washington 25, D. C. and ask for bulletin 5-35-1(58).

**Printed Circuits at Plateau**

The Institute of Printed Circuits has announced a "leveling off" in its growth pattern. Sales in 1957 were about 10% over 1956 and the second half of 1957 ran only 6% ahead of the comparable months in 1956. Many electronic component firms have withdrawn from the field (annual turnover of 38%) because of the slim profits resulting from overcapacity. . . . New Mark 32 torpedo launching tube assemblies made out of fiber glass are being built for the Navy by the Apex Reinforced Plastics Div. of White Sewing Machine Corp. One assembly of three tubes weighs 2000 lb.

**Up-to-date Jules Verne**

The Russians are taking a page from Jules Verne in converting a submarine to an underwater scientific laboratory. According to reports, the sub will have special windows forward, powerful searchlights, and special instruments. Comfortable armchairs by these windows will permit leisurely observance of marine life. . . . A new process for the recovery of high grade alumina from low grade ores and coal mine wastes has been announced by Strategic North American Corp., a company formed by North American Coal Corp. of Cleveland and Strategic Materials Corp. of Buffalo. The basic process uses an acid leaching technique, reportedly the first commercialized. Conventional process requires imported high grade bauxite. . . . British Government plans to make operators of privately-owned atomic reactors liable for damages up to $14-million in case of disastrous accidents.

## Solar Heating on Trial in Northeast, Southwest

NEW YORK—Experimental solar-heated homes are under construction in frigid Massachusetts and sunny Arizona. The Massachusetts house, built by a team of MIT engineers and architects, is a two-story, three-bedroom structure with a hot water-solar system to provide winter heat, summer air conditioning and year-round hot water.

Solar radiation will furnish 75 to 80% of the house heat and will be supplemented during prolonged cold spells by an auxiliary oil furnace. The sun's heat will be collected by a 640-sq ft, .025-in.-thick aluminum sheet painted radiation-absorbing black. The aluminum will be covered by two layers of glass, and will cover the building's roof and south side.

Heat absorbed by the aluminum is transferred to water circulated through copper tubes to a 1500-gal tank. A heat exchanger transfers heat from the water tank to air, is forced through ducts and registers to the living space as needed.

Living room of the house is on the second floor, with a master bedroom, bath and dressing room. Ground floor has two bedrooms, bath, dining room, kitchen, entry hall and several closets. The home will be sold to a private family, but MIT engineers will retain access rights to instruments recording performance of the solar-heating system. Though technically feasible, the system is still a long way from being economical MIT engineers estimate it will cost about six times as much as a conventional system giving equal comfort.

Arizona's solar-heated house near Phoenix was developed from Peter R. Lee's prize-winning design for the International Architectural Competition conducted by the Association for Applied Solar Energy.

Solar radiation is collected by movable louvers overlaying a central court and two patios on the north and south ends of the house. The louvers are adjusted daily to the best angle for collecting sun's energy in cool weather or reflecting it in summer.

Louvers will heat the house and swimming pool in winter, provide hot-water requirements year-round and minimize cooling load in summer. A heat pump will supply additional heat during protracted cold spells.

Concrete floors of the house are supported on a network of metal domes over a sub-floor. Air circulating through the domes warms the floors in winter and cools them in summer. After heating or cooling the floor, the air enters rooms through grills in the north and south faces of the house. The structure will be completed in mid-March.

## Lots of Small-lot Production Coming Up

LONG ISLAND CITY—A milling machine designed to make automation of small-quantity production economically feasible has been developed by the Morey Machinery Co. here and GE's Specialty Control Department, Waynesboro, Va.

The magnetic tape-controlled profile and contour milling machine is designed to machine precision aircraft parts from ferrous and nonferrous metals. The tailor-made, 3-motion magnetic-tape-control system automatically directs vertical, horizontal and longitudinal milling at rates up to 100 ipm and at tolerances as low as 0.001 in. Similar tolerances are possible at traverse of 200 ipm.

"This high-precision miller and electronic control are now available at a price—well under $100,000—the small and medium-sized plant can afford," reports Leonard Morey, president of the machinery company "probably the lowest price at which fully automated equipment of this sort has ever been sold."

The machine is capable of handling heat-treated tool steels as well as aluminum, magnesium and similar metals as large as 48 x 48 x 12 in. Since feed motions of all three axes are numerically controlled from magnetic tape, the cutter can be positioned or directed for all contouring operations.

## Copyright Code Could Crimp Translations

NEW YORK CITY—Russia is passing out word to US firms translating Soviet technical material that they may soon have to clear with the Reds for permission to publish translated copy and also pay a royalty fee for scientific articles that are printed here.

The Russians say they plan to adhere this year to the Geneva Universal Copyright Convention. Under Convention rules the Soviets would have legal property rights to printed Russian material coming into the US.

#### COULD HURT US

In effect, the move could put a crimp in the planned large-scale translation program now gaining momentum. It would affect nontechnical as well as technical information. A US firm translating nontechnical Soviet material says the Red proposal would give the Russian government control over translation and rights to royalties over a wide range of materials other than scientific journals. Such rights might make it possible for the Russians to more carefully regulate publication here of material they do not want printed.

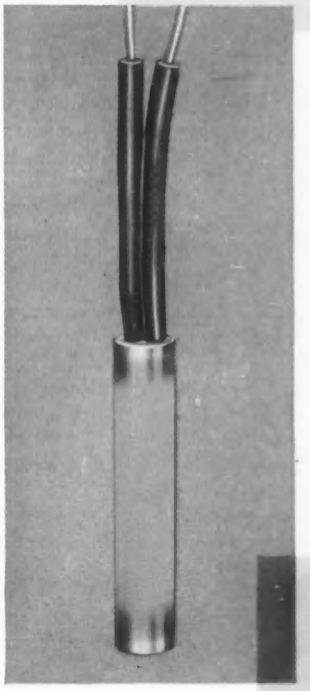
Currently, there is no legal protection for Soviet property rights in literary and related material in the US. Same applies to US property of similar nature in Russia.

#### THIS IS SOMETHING NEW

In both countries much of such material is translated and disseminated without permission or payment. In the opinion of US firms translating Russian material, Soviet adherence to the Geneva Convention would mean that the Reds also would have to clear with US publishers in order to reprint our scientific material. To date, some Soviet payments have been received by American authors of scientific books translated and published in Russia, report the translating firms.

This consideration clashes to some extent with efforts being made by Western Reserve Univ., in conjunction with government and industry, to solve the problem of foreign language translation. Should USSR copyrights prevail, a vast program of language indexing and retrieval might be bottlenecked.


FIROD®
CARTRIDGE HEATER



OPERATED
IN OPEN AIR
AT 1800° F.
FOR 720 HOURS
AT 90 WATTS sq. in.

5 times more heat than any standard cartridge heating unit...plus longer life

**ACTUAL TESTS** – not just claims – are proving the superiority of the new WATLOW FIREROD Cartridge Heating Unit.

Take, for example, the endurance test headlined above: a FIREROD unit, rated at 115 v., 250 w., and measuring 2¼" long x ½" dia., has been operated at a sheath temperature of 1800° F. for more than 720 continuous hours. A conventional unit of similar size would last *just minutes,* even though rated at much lower wattage!

In actual use, this means you can operate a WATLOW FIREROD at higher watts densities and temperatures and still get long life – or operate at normal watts densities and temperatures and get greatly extended life.

FOR ADDITIONAL TEST INFORMATION, *operation data, style information, etc., write for your* ***FREE Illustrated Watlow Bulletin.***

WATLOW
ELECTRIC MANUFACTURING CO.
1392 Ferguson Avenue
Saint Louis 14, Missouri

# Automatic Traffic Control a Step Closer

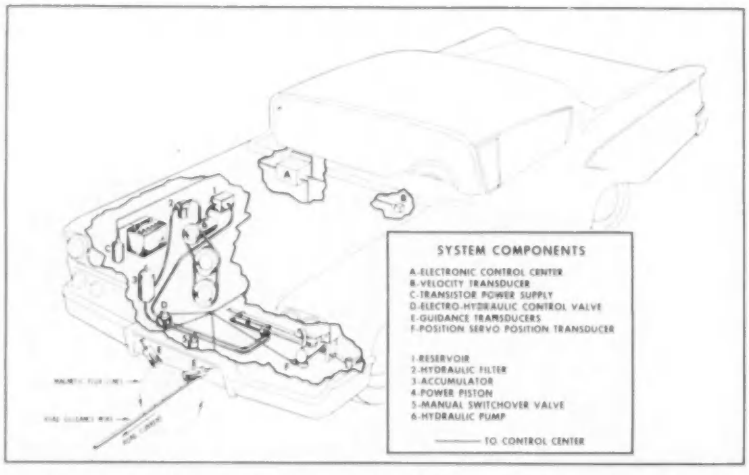
DETROIT—America's highway hazards may soon be a thing of the past thanks to a versatile electronic control for automobiles now under test at the General Motors Technical Center. Ultimate goal is a superhighway safety system that will control steering, speed, and braking through electronic computers in each vehicle. Idea is also under development at RCA David Sarnoff Research Center. (*PE —Jan. 27, '58 p. 11*)

### INSTALLED UP FRONT

GM's "automatic driver," which connects to the power steering, can be installed on the car's front bumper. A cable in the roadbed carries a low-frequency alternating current that creates a circular magnetic field along the cable's length. A pair of tuned pickup coils on the bumper straddle this field. Because the coils have a voltage across their terminals that varies with the magnetic-field strength, any lateral motion of the car causes a voltage differential between the coils. A computer measures the differential and automatically adjusts steering through an electro-hydraulic servo system to put the car back onto the magnetic path. GM also is investigating simplified mechanisms for controlling distance between cars, and car speeds. It's estimated that the automotive portion of the system could be produced at about the cost of good automobile radios.

First stage in RCA's system has already been demonstrated. It features a series of roadside lights connected to detector circuits buried beneath the pavement. As the car passes over the hidden detectors, its passage is traced by the lights, warning vehicles behind to keep a safe distance. According to RCA, this development could be put into operation in the near future without requiring any special equipment in cars.

Later, utilizing a radio warning system, cars could be equipped with a signal system that would activate automatic control of brakes. Vehicle could also be equipped with dashboard indicator to show distance of clear roadway ahead, even at zero visibility. Ultimately, automatic control devices would sense suitable opportunities for passing other cars and would change travel routes in response to a preset computer program. The driver would have to take over only as he left the high-speed road system's "electronic drive." This would serve as an attack on the main arteries of traffic havoc.




**System components** for GM electronic control device promise to provide much-needed super-safe highway control system.

# Soviets Rush Metals— but Need Guidance

NEW YORK—Two GE metallurgists just back from Russia—J. H. Hollomon and Walter R. Hibbard—say the Soviets are pouring considerable money and manpower into metallurgical research. But the Russians appear to have a shortage of top research management talent. The scientists aired their views here at a meeting of the Institute of Metals and the Iron and Steel Divisions of the American Institute of Mining, Metallurgical and Petroleum Engineers.

Some characteristics of Russian metallurgical research noted by the touring scientists were:

A few individuals hold several jobs each and play a large role in directing manpower and budgets. Pyramided control limits the range of judgment that goes into planning research programs. And though individuals carrying on research are extremely capable, the narrow view from the top may have a detrimental effect on total balance of the Russian metallurgical effort.

### STRESS ON FERROUS

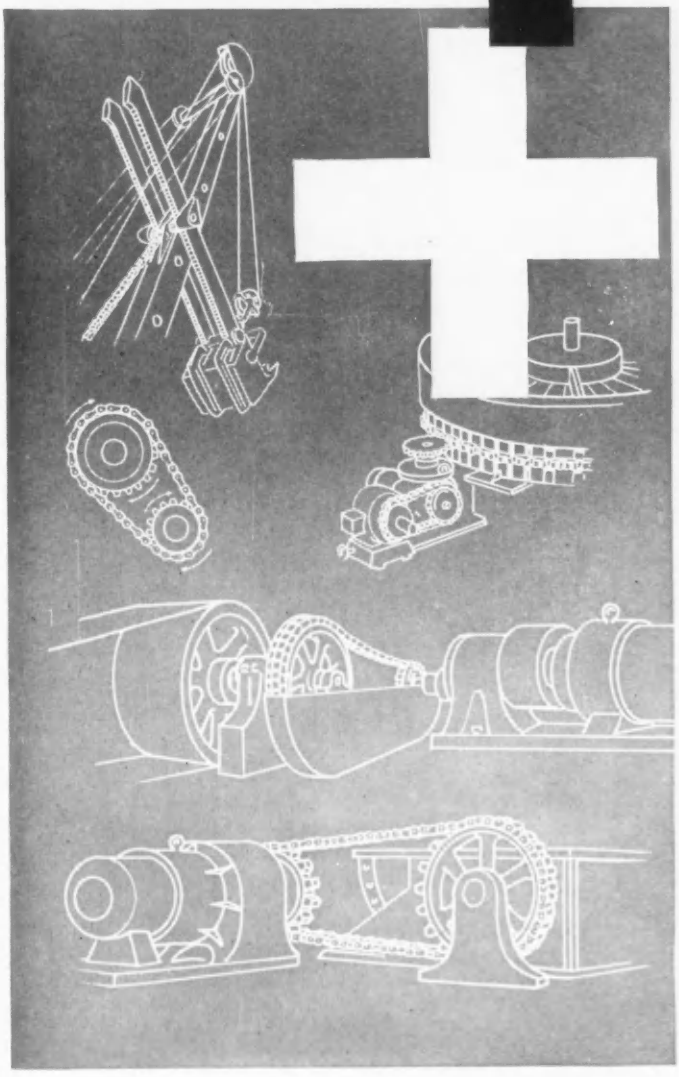
Great stress is currently put on research into production of ferrous and nonferrous metals, reflecting "the appreciation in governmental, industrial and academic institutions of the needs of the nation and the tendency to concentrate research in certain areas to meet these needs."

Intensive research on vacuum and arc melting is aimed, the GE observers surmise, at obtaining high-temperature alloys, and not at gaining scientific knowledge of metals generally.

Once the Russians start to investigate a subject, their scientists cover it intensively and extensively. "They carry on many types of experiments and measurements on an empirical basis. Such a program requires considerably more manpower than one designed on a mechanistic basis." And it requires an enormous management and coordination effort in order to supervise to an efficient end.

Russian scientists and engineers have a remarkable familiarity with scientific literature of Russia, Western Europe and the US. Metallurgical students are required to translate English at 500 words an hour for graduation.

# to put a PLUS in your



# POWER DRIVES

*Plus* performance, dependability, economy...these are the extras you want in your designs. But in specifying power drive equipment, how can you be sure that you're getting *plus* values?

One *sure* way is to consult your CHAIN Belt Man. Have him demonstrate the three important *plus* advantages you get with CHAIN Belt:

1. *Plus Value in Product.* Whether it's chain, sprocket, bearing, coupling, take-up, the built-in *plus* quality of CHAIN Belt products puts plus value in your equipment.
2. *Plus Value in Application Assistance.* Your CHAIN Belt Man has the know-how to help you select the right component that assures plus performance at lowest over-all cost. Because he has a complete line, he can recommend, without prejudice, the right choice for your design.
3. *Plus Value in Service.* From your CHAIN Belt Man in the field to the engineering and manufacturing departments in our plants, *plus* service is yours to command. In application, product specification assistance, deliveries that meet your schedules, CHAIN Belt has no equal.

For the story of the *plus* values in CHAIN Belt power drive equipment, turn the page.

**CHAIN BELT**

*QUICKENS THE PACE OF PROGRESS*

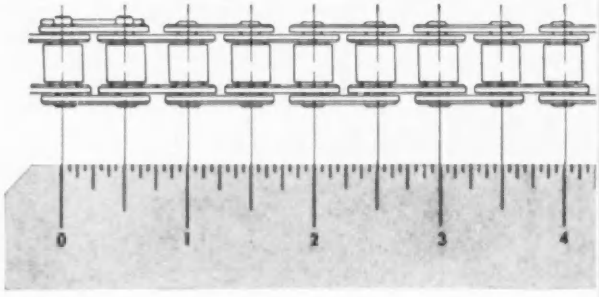
turn page

# the PLUS values in...

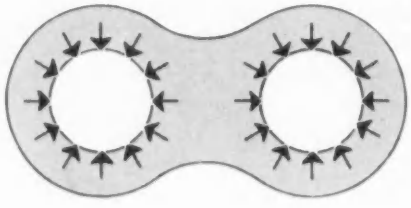
## REX® ROLLER CHAIN

The quality of any roller chain can be determined by two factors...its ability to resist wear and fatigue! A chain designed and manufactured to have a longer normal wear life and greater fatigue resistance is a *plus* quality chain. CHAIN Belt's quality in design...manufacture...control...gives you this *plus* ability to resist wear and fatigue. Here are two of the many important differences that make Rex Roller Chain so superior:

## IN PITCH CONTROL




In Rex Roller Chain, chain pitch is accurately controlled, not only in the pitch measurement in a chain strand *but in each link* in the strand. This means that every part of the chain carries its full share of the working load. There are no pitch variations to cause uneven loading with resulting early failures of chain parts.

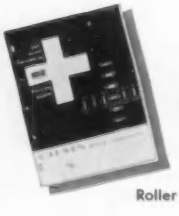


## IN LINK PLATES

An important function of the link plates is to maintain the pitch of the chain. To do this, link plate holes must be accurately located in relation to each other and also parallel. To control the drive fits of pins and bushings, plate holes must be accurate in size throughout the thickness of the link. Hole finishes must be smooth and uniform.

You get these features in Rex Roller Chains through a special manufacturing technique of guided piercing of link plate holes...a technique that assures the exact type of link plate hole required, and puts the *plus* wear life and fatigue resistance into these top-quality chains.

For the complete story of the plus values in Rex Roller Chains, send for your copy of Bulletin No. 5725.



**CHAIN BELT**

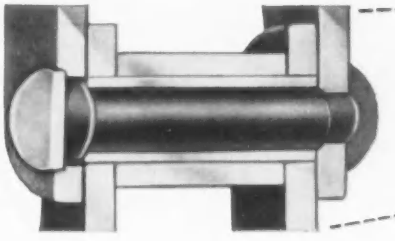
4715 W. Greenfield Ave., Milwaukee 1, Wis.

Roller Chains • Leaf Chains • PlateTop Chains • Double Pitch Roller Chains • Sprockets • Couplings

# the PLUS values in...

## REX® CHABELCO® CHAINS

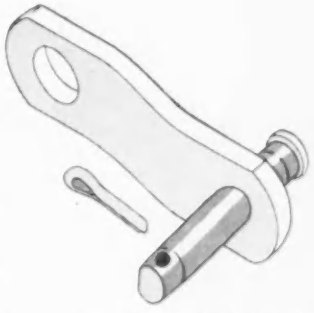
Where you need power drive chains to handle heavy loads at slow to moderate speeds, the plus quality in Rex Chabelco Steel Chains can put *plus* value into your equipment. These chains, in their service range, are your most economical choice ...will transmit more horsepower per dollar. They have the rugged strength... the designed-in dependability...that resist heavy shock loads and tough operating conditions. Here are two important reasons why:



## IN PLANNED TOLERANCES

The press fit of pins and bushing in chain side plates is an important factor in chain life...in its ability to resist shock loads. In Rex Chabelco Chains, these tolerances are "designed in" and held through precisely controlled manufacturing techniques. Even the pins and rivets of these chains have highly finished surfaces to provide the required precise fits. You get the maximum bearing area for longest possible chain life.

## IN POSITIVE LOCKS



Turning of the chain pins in the side plates causes excessive wear in the side plate hole in any chain...destroys chain pitch...results in early chain failure. In Rex Chabelco, pins have a special-shaped milled flat on the end which fits into a special hole in the side plate. This positive lock, plus the controlled press fits, prevents any turning of the pin...assures longest chain life. For the story on Rex Chabelco Chains, send for your copy of Bulletin No. 56-57.

**CHAIN BELT**

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Chabelco Chains • Cast Chains • TableTop Chains • Drop Forged Chains • Sprockets • Set Collars • Elevator Buckets

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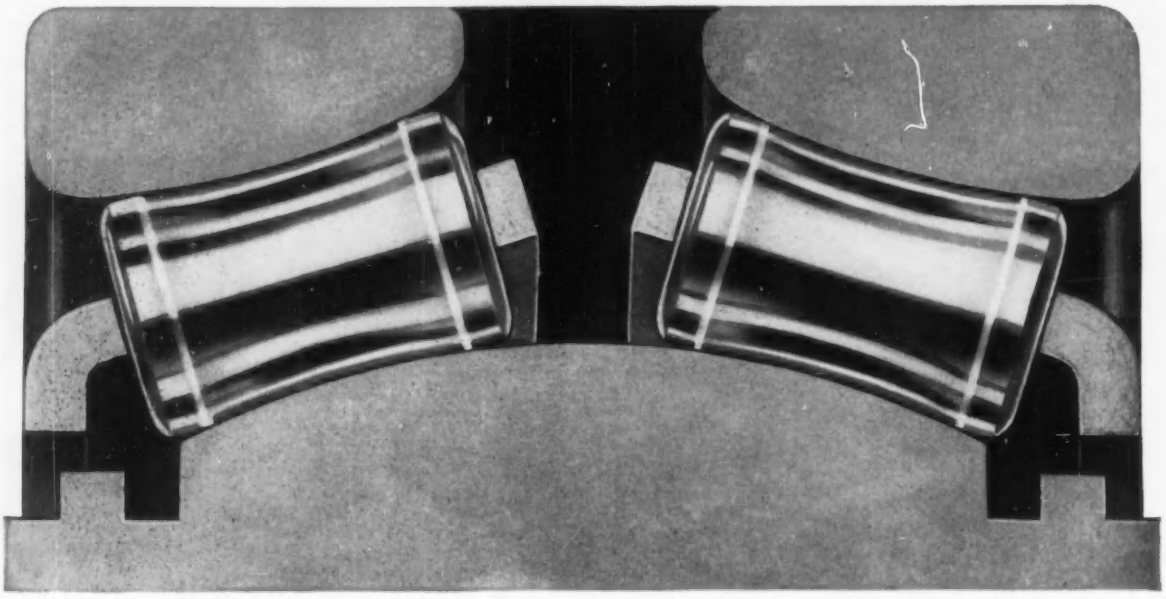
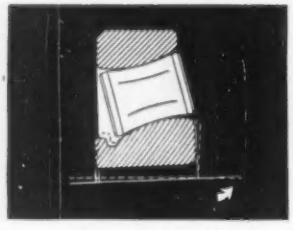


# *the* PLUS *values in* SHAFER® BEARINGS

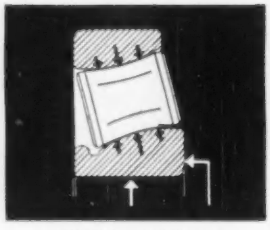
Combine the low-rolling friction of a ball...the high load-carrying capacity of a roller...and you have the *plus* advantages in Shafer Self-Aligning Roller Bearings. These bearings maintain their high load-carrying capacity under shock loads...continuous heavy-duty loads under misalignments.

Specifying Shafer puts an important *plus* in better service...longer life for your customers. Remember, a Shafer Bearing will deliver its rated load capacity for *five years or more*. Compare this with other bearings with an average life rating of one year or less. Here's why!



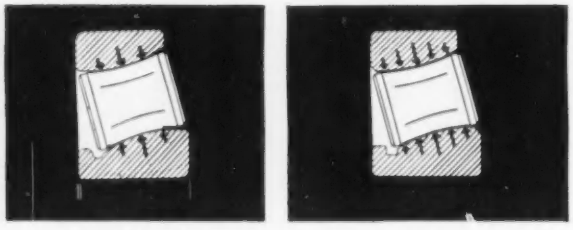
**SHAFT DEFLECTION**

Shafer design permits unrestricted compensation for shaft deflections, misalignment, shock loads...permits a total of 3° of misalignment.



**RADIAL, THRUST OR COMBINED LOADS**

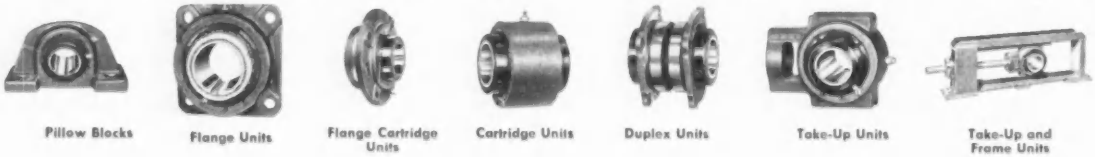
Shafer free-roller design handles radial, thrust or combined loads without loss of bearing capacity. There is no roller end wear...no need for guide flange at roller end.



**Under Normal Load** **Under Heavy Load**

**SHOCK RESISTANCE**

The high inherent elasticity of the bearing-quality alloy steel rollers and raceways provides maximum resistance to shock loads. The elasticity of these rollers and raceways permits compression under load and shocks... the contact area increases to fit the bearing area to the load requirement.



Pillow Blocks | Flange Units | Flange Cartridge Units | Cartridge Units | Duplex Units | Take-Up Units | Take-Up and Frame Units

# CHAIN BELT

4715 W. Greenfield Ave., Milwaukee 1, Wis.

**For complete data on the *plus* advantages of Shafer Bearings, write for your copy of Bulletin No. 55.**

# design IS MORE THAN NUTS AND BOLTS

**Too much emphasis on details often blinds designers to the more basic requirements. Here's a checklist—lest we forget what design is really about.**

**MORRIS P. TAYLOR**
Mechanical Engineering Department
California State Polytechnic College

■ Design is a lot more than stress, deflection and function. Textbooks and college courses rightly emphasize these fundamentals, but industry needs men with a broader viewpoint.

Stop for a moment and look at your current design project from a distance. Many of the requirements to be listed here you have met automatically—without conscious thought. Others may have been overlooked, at the risk of major redesign later or complete product failure.

Design requirements are of two types: absolute requirements that must be met by any design, and relative requirements that apply to certain products—depending on use, function, customer demand and similar changeable factors.

### I. Absolute Requirements

These are of a general nature. They apply uncompromisingly to any design.

**Normal function.** The machine must do its job and do it reliably. Gun must shoot, ship must float, automobile must run, typewriter must write.

An established product will meet these requirements almost automatically. With a totally new design, however, workability may be, and often is, the most difficult problem. Early automotive engineers and airplane designers—like the pioneers in any field—all had to solve this problem first. It is now the greatest problem in missile design. It is the most basic design requirement.

**Legality.** Engineering design and construction is often regulated by law. The design of civilian aircraft, railway equipment, certain components of automotive equipment (such as brakes and lights), and some phases of ship design are regulated by Federal codes. Pressure vessel design is governed by state laws, usually based on ASME codes. There are also State Industrial Accident Codes covering safety guards and devices, and the requirements of insurance companies and underwriters' associations.

**Specifications.** In design projects carried out for technical customers (governmental bodies, utility and manufacturing concerns, etc.) the product must meet a number of specifications set up by the purchase contract. These may specify performance (output, for example, and efficiency) or enter into phases of detail design, allowable stresses, and other such matters. However, there is a growing feeling among engineers, both buyers and sellers, that such specifications should be limited to ultimate performance only; that tying down detail design requirements interferes with engineering progress.

**Safety.** A design must be safe against any reasonable abnormal condition. It must not be delicate and fragile. It must also be safe from the standpoint of industrial accident or hazard to user or operator. Guards should be provided for all moving parts. Motions should be interlocked in sequence so that accidental operation is automatically prevented. As examples: artillery pieces have "salvo latches" to prevent firing if the breech block is not fully locked and other parts are not in correct position; high-speed punch presses have photoelectric or other cutout switches so they will not move if the operator's arm is in a dangerous position; automobiles have switches so the engine cannot be started if the car is in gear.

**Vibration.** Every effort should be made to reduce or eliminate vibration. Entirely apart from its effect on peak stresses, which may be very serious, vibration is annoying and tiring to operators, and even to occupants of nearby buildings.

**Noise and fumes.** Noise, obnoxious fumes and contamination of discharge water should be reduced as far as possible, in all products except in some sorts of military apparatus. In civilian life, no one has a right to commit a nuisance, and such action is subject to law suits.

**Convenience of operation.** Controls, gages, operating handles, and warning lights should be conveniently and logically located. This makes satisfied customers and users, and contributes to safety of operation.

**Lubrication.** Provision should be made for the lubrication of all running surfaces. Except under unusual circumstances, standard lubricants should be used.

**Parts availability.** Any parts that cannot be expected to last the normal life of the unit (such as spark plugs and tires on automobiles) must be easily replaceable.

**Transportability.** For certain very large products, such as central station apparatus for power companies, mining machinery, large irrigation valves, the designer must be sure the largest individual or factory-assembled part can be moved to the site by rail, water, truck, or whatever transportation medium is available.

**Balanced design.** Although this is not strictly an absolute physical requirement, any good design should be balanced. Parts should be reasonably uniform in strength, apart from intentional weak links meant to fail before other more valuable parts are injured. Except for such weak links, parts should be equitably proportioned; "don't tie up a row boat with a three-inch hawser."

### II. Relative Requirements

Here are the requirements that apply to a specific product, depending on its nature, use, customer demand, and such. Some of these factors, such as light weight and low cost, or efficiency and performance, may be conflicting. Certain of these requirements are obvious—such as light weight for aircraft components and long life for central electric power stations. However, their relative importance is often debatable.

**Initial cost and efficiency.** These two factors are considered together,

as they are often related inversely—a more efficient machine is usually more expensive. This is not an absolute rule; in several instances, such as development of the high-compression internal combustion engine, efficiency was increased and cost reduced. But the more efficient design is often more expensive, so the engineer must decide how much he is justified in increasing first cost to get increased efficiency.

The connecting variable is the load factor—actual work output divided by the potential maximum output, the final criterion being that over-all cost per unit of output (operating cost, interest on investment, and depreciation) shall be a minimum. Where reasonably accurate data can be obtained, the computation is relatively simple but with many machines such as passenger automobiles, household mechanical devices, private aircraft, and outboard motors, the load factor is not only low but extremely variable among different users. For commercial users, such as public utilities, manufacturing plants, and transportation systems, the load factor is more definite.

When machinery is worked at or near full load much of the time, efficiency is extremely important and a more efficient machine can usually justify its additional first cost. With equipment run occasionally and at light loads, first cost should be as low as possible. As a homely example, a household washing machine costing twice as much, even though using half the electric power, would not be saleable.

**Overload capacity.** Certain machines must have capacity to work short periods at loads over normal rating. Overload capacity is usually zero for most machines driving fans, blowers, marine propellers, centrifugal pumps, and such apparatus. In other machines, such as diesel locomotives, overloads are prevented automatically by both the electrical control and the limit of adhesion. However, in aircraft engines and equipment, a definite short-time overload capacity is required for take-off. In powered excavating and earth-moving machines, overload capacity is needed to loosen and cut into solid material, and handle harder material met unexpectedly during a cut. Hydraulic couplings or converters are used in such machinery to limit and control shock overloads.

The question—how much overload capacity?—is often difficult to decide Should an automotive cooling system be able to handle an engine pulling the heaviest house trailer over the toughest highway grade on the hottest day?

**Capacity to absorb unusual shocks.** This is usually a matter of judgment. Obviously, such capacity cannot be infinite. An airplane cannot be designed to run into mountains—nor can automobiles crash head-on at high speed without injury or damage. However, an airplane should not be damaged by a rough landing, nor should an automobile frame be buckled by a minor traffic accident.

In certain cases, such as commercial aircraft, ships, and railway equipment, arbitrary accidental shock factors for design have been set up by legal groups. It is then only necessary to design for the hypothetical conditions.

**Weight.** The importance of weight varies with the product. In aircraft it is extremely important. In rail and road vehicles it is also important, especially in highway transport where, with legal limitations on gross weight, any savings in truck weight means just so much more payload. Portable equipment of any kind should be weight-controlled.

In stationary machinery, weight is important only as it affects cost: unnecessary and excessive weight is usually expensive. Although it is not good practice to use high-strength alloy steels throughout, over-all design cost can often be greatly reduced by these alloys in certain key parts. For instance, in a complicated mechanism involving a gear drive, alloy gears and shafts permit smaller gears, shaft centers can be placed closer, and the size and weight of the entire assembly is reduced.

Good design always aims at small size and low weight. Use direct stresses, avoid overhung and curved beam supports where possible. Use material for as many loads as possible and avoid needing a separate frame or bracket for each part. In this connection, internal gears will often save money—reducing bulk and weight by bringing shaft centers closer.

**Longevity.** The designed life of a product should be reasonable, and suitable to its use and desires of the user. Many designs are for limited life. Military products should not be designed, and often cannot be, to run forever. Aircraft equipment must be designed for limited life under extreme takeoff loads. Automotive transmissions for passenger cars are not designed for continuous operation at full load and speed in the lower gears, which are seldom used. However, pumps, blowers, central station power plants, and marine propulsion plants must be designed for long operation at full load.

The modern tendency is to design for more output per unit of material. With continuous improvement and resulting rapid rate of obsolescence, and with more accurate stress analysis, designing with low stresses to last forever is poor practice. Good material should not be pampered by calling for unnecessarily high factors of safety.

**Producibility.** A good design must be such that it can be manufactured and, as far as possible, with standard tools and facilities. But when developing new machinery or designing machines to be produced in large volume, the designer must not be too bound by existing tools. Many of the important "break-through" designs—those that have opened up new horizons—involved new and unique tooling problems. The steam turbine, the ball bearing, the radial aircraft engine, the gas turbine, the hydraulic torque converter—all involved special manufacturing and material problems. However, the designer should not require special tooling, or unusual precision, unless these are unavoidable or some very definite gain is made.

Standard materials and standard parts—fastenings, bearings, oil seals, and such—should be used wherever possible. With so wide a range of standard parts available, both in size and quality, the designer must be prepared to fully justify a decision to specify special parts.

**Maintainability.** Easy lubrication should be possible. Accessibility for easy repair and overhaul is also important, but can be overemphasized. Accessibility was important to early cars, which required frequent repairs. In modern cars, which stay out of the

shop for long periods, it is much less so. However, machines should not be made unnecessarily difficult to work on by careless design–when a little forethought would improve conditions at no extra cost.

The question of designing for special wrenches, repair jigs, and such devices is one for applied intelligence. Often, large savings in weight and bulk can be made with special tools. In large volume machinery for technical users, such as diesel locomotives, there is no objection to special jigs for overhaul. In fact the users are themselves quite ingenious in developing such devices. With machines such as farm machinery, to be used in remote locations by nontechnicians accessibility for ease of repairs with a minimum of standard tools is very important.

**Appearance.** Products purchased by the general public–such as automobiles and household devices–must have eye appeal. The question of just what is a pleasing appearance is one of psychology and esthetics. Producers maintain industrial design and style departments to handle such problems. Even with such help it is not always possible to guess the public reaction.

With products for commercial and technical users, such as trucks, farm machinery, pumps, steam generators, turbines, and military aircraft, appearance is less important. Here the designer is not justified in spending much time on good looks, except that cover plates, housings, etc., should be made smooth and pleasing in appearance when complications won't result. A minor point–avoid inaccessible corners and crannies that are hard to clean.

Fortunately, a straightforward and successful design generally looks good to the technical user.

**A last word of advice.** Most new products proceed through a series of mockups, prototypes and test models before release for production. In the mockup and prototype stages, it is probable that certain needed improvements, changes and corrections–not caught on the original layout–will show up. Without in any way approving careless layout work, the designer should not let himself be mentally "thrown" by such occurrences. Very few new devices work perfectly the first time. ■


## design-in CAMLOC...design out costs

These DC amplifiers by Hallamore Electronics Company, Anaheim, California, use Camloc 21L Chassis Latches in place of the usual innumerable pieces of hardware. Besides obvious advantages of dependability, styling, reduction in weight, functionalism, the 21L saves money in production time through design versatility, simplified installation.

CAMLOC

21L

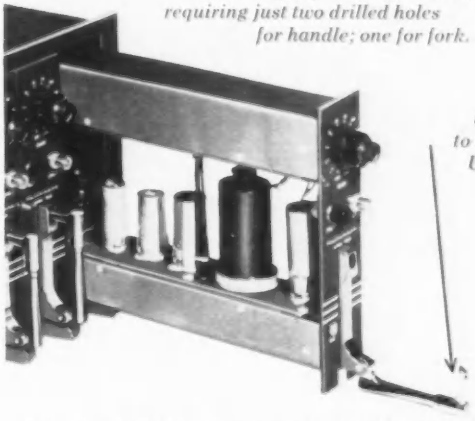
**multiple function CHASSIS LATCH**

*Push-type spring in handle engages and disengages lock in one easy motion.*

*Cam action is positive, vibration-proof, easily manipulated.*

*Fork arrangement automatically disconnects and ejects chassis: makes perfect reconnection.*

*Mounting is quick, economical, requiring just two drilled holes for handle; one for fork.*



*Handle leverage is sufficient to disengage 400-lb. friction load. Ultimate carrying capacity of closed handle is 600 lbs.*

See it on display at the IRE Show, Booths 4306, 4308, March 24-27, NewYork City

Design Engineering Show, Booth 317, April 14-17, Chicago

For complete information, ask for **BULLETIN No. 27L**

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# DESIGN EN

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## APRIL 14-17, 1958

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*Discover new materials.*

*Pick up hundreds of new ideas.*

*Talk to the man who engineered it.*

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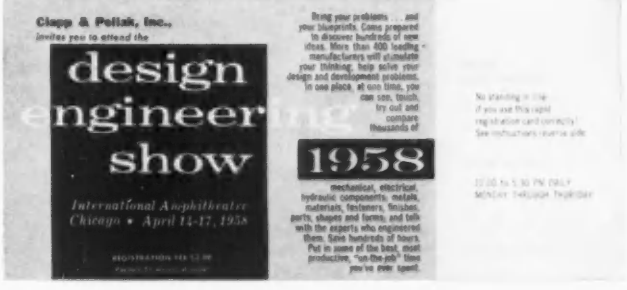
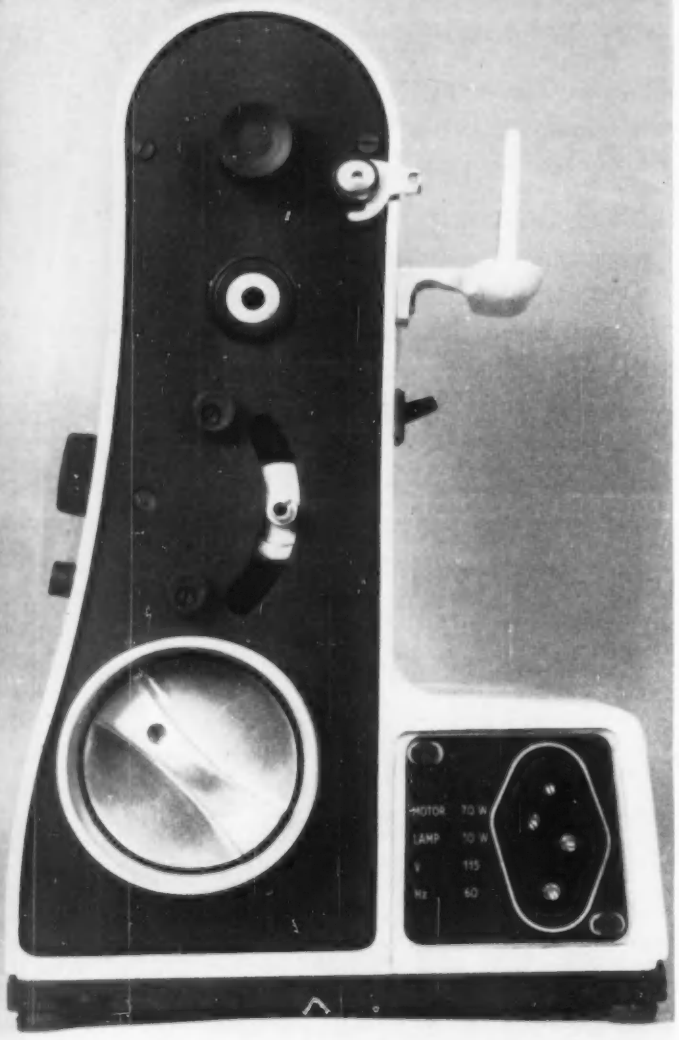
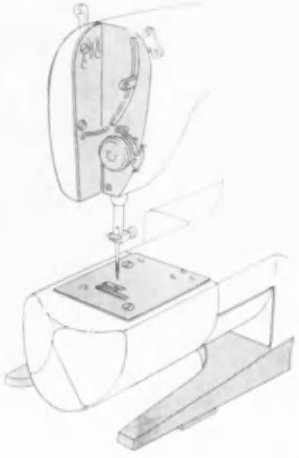
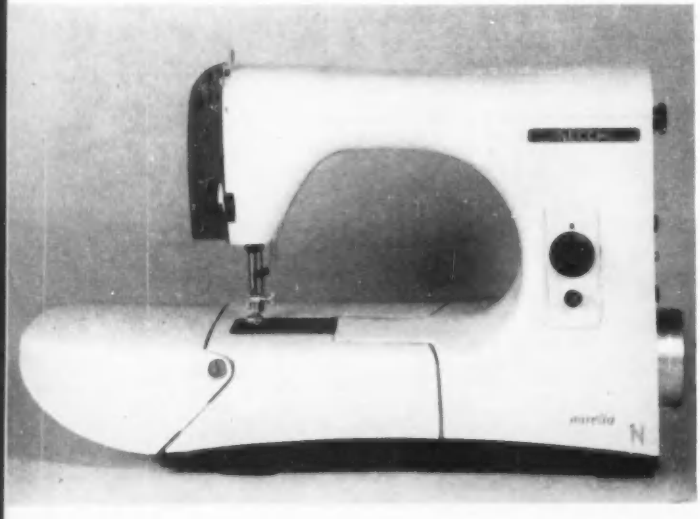


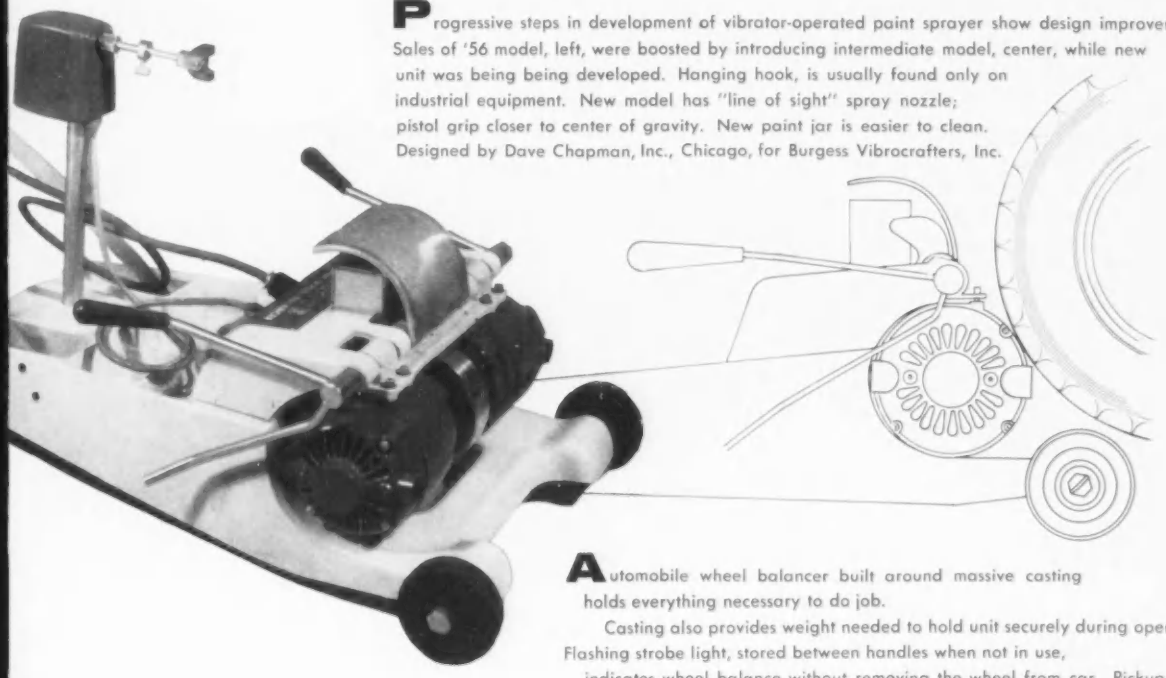






Latest sewing machine for the home by Necchi-Elna goes back to the rounded arm that once characterized both foreign and domestic machines. Italian industrial designer Marcello Nizzol has given the "Mirella" a flat bed that slides off after loosening of single thumb screw. Sewing of sleeves, darning of socks is done on remaining narrower bed (see sketch above). Motor is now in base instead of arm, which puts balance wheel where it can be reached without operator lifting hand. Almost all knobs, levers and other protuberances have been concentrated in black panel at right and in right-angled cutout in needle end of arm. Spool pins have been moved to side, away from traditional top location, and out of the way.

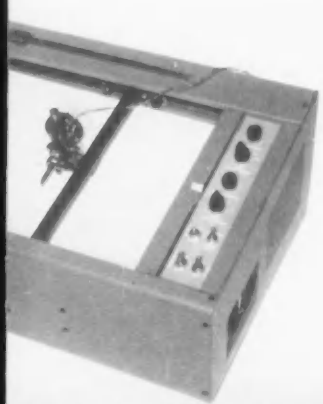
# in appearance design



Progressive steps in development of vibrator-operated paint sprayer show design improvement. Sales of '56 model, left, were boosted by introducing intermediate model, center, while new unit was being being developed. Hanging hook, is usually found only on industrial equipment. New model has "line of sight" spray nozzle; pistol grip closer to center of gravity. New paint jar is easier to clean. Designed by Dave Chapman, Inc., Chicago, for Burgess Vibrocrafters, Inc.

Automobile wheel balancer built around massive casting holds everything necessary to do job.

Casting also provides weight needed to hold unit securely during operation. Flashing strobe light, stored between handles when not in use, indicates wheel balance without removing the wheel from car. Pickup unit held against running gear gives a visual reading of degree of imbalance. Unit provides speeds over 100 mph to simulate high roadspeeds possible in today's cars. Manufactured by Alemite Div. of Stewart-Warner Corp.



The problem—to improve appearance, simplify maintenance and reduce manufacturing costs of electric plotting board. Solution—a major change in the case, resulting in better construction and professional look. New case has hinged front and back panels. Its design also made possible 8-hr reduction in assembly time, more than compensating for higher cost of case. Designed by Raymond Spillman for Electronic Associates, Inc.

## ANOTHER IDEA-PROCESS FROM A.O. SMITH...

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### A. O. Smith's "total-use-of-metal" process adds new dimension to metal fabrication

This steam turbine blade is a current example of A. O. Smith's production creativity. It was formed by our new E.D.O.S. process — which has *already* brought dramatic savings (as high as 70% compared to conventional methods) in metal *and* machining time to the aircraft and other metal fabricating industries.

Developed by A. O. Smith research, E.D.O.S. means engineered designs for optimum structures. Specifically, it consists of precision forging, contour rolling, flash and fusion welding . . . to put all of the metal to work.

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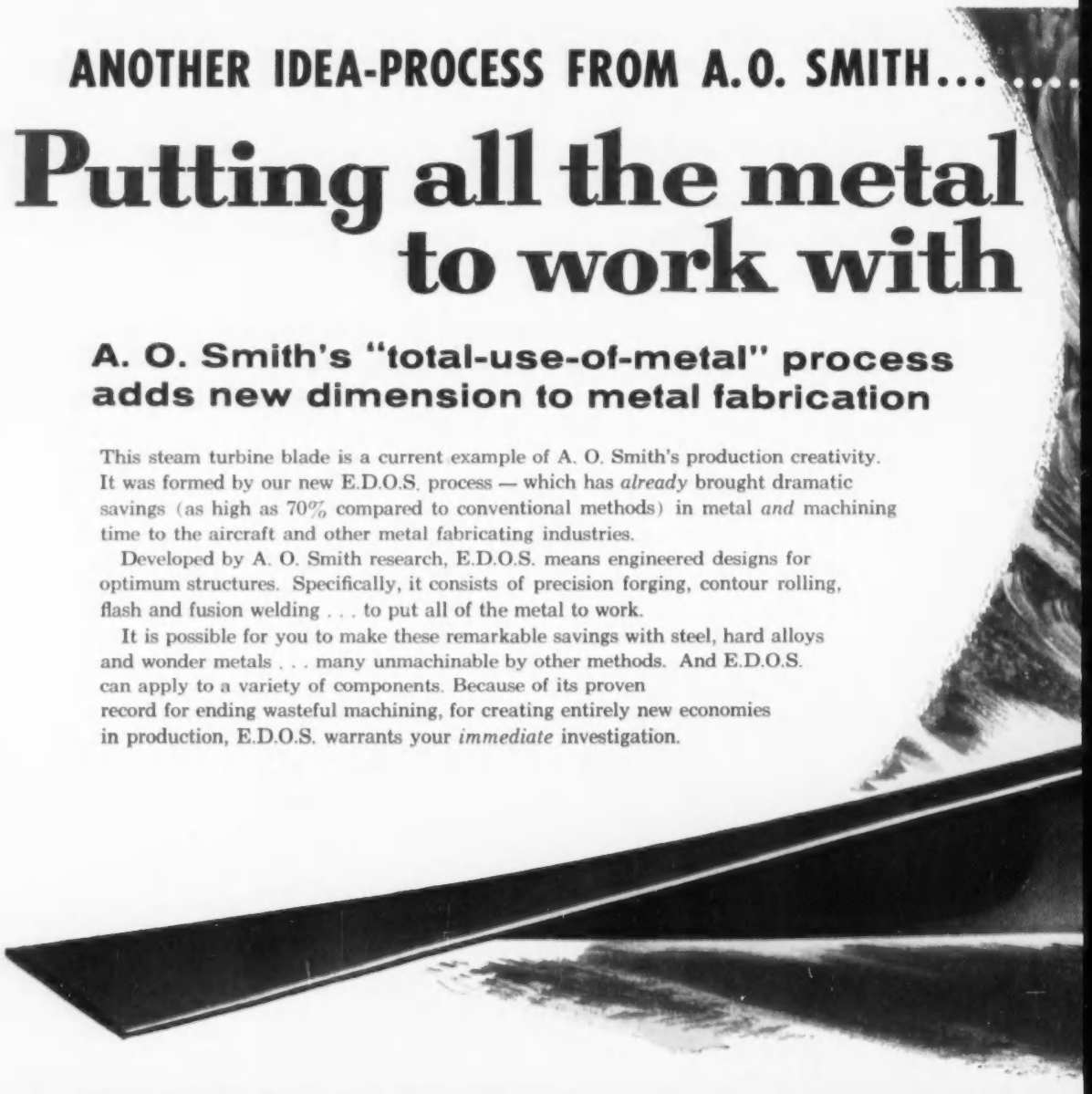


## * E.D.O.S., Engineered designs for optimum structures...

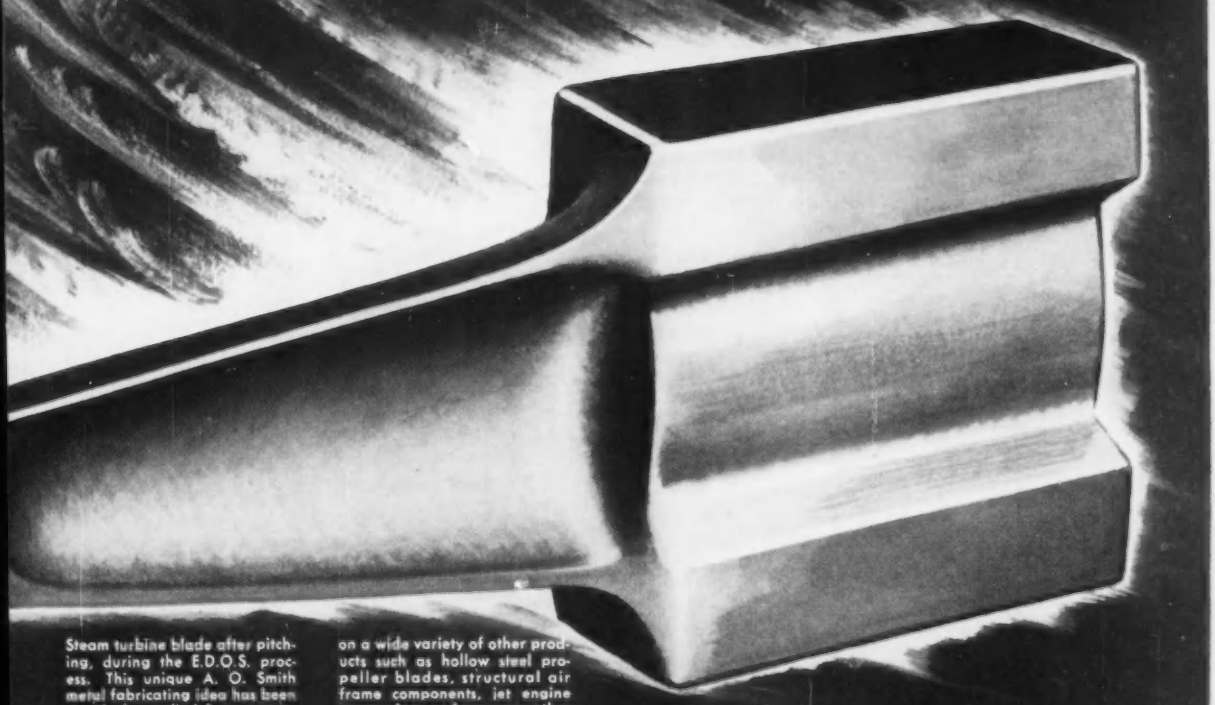
Original type 403 stainless steel billet before processing.

Fillout after initial precision forging operation has been completed.

Forged piece is successively rolled out to blade's full length.

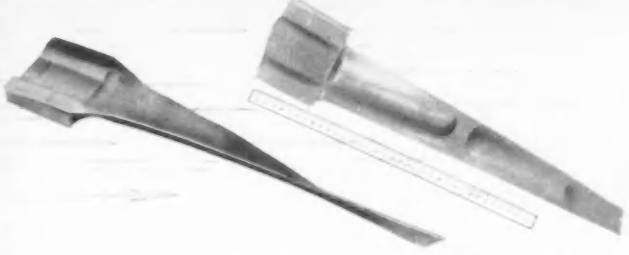
... partner in your progress through creative mass production

# E.D.O.S.*



Steam turbine blade after pitching, during the E.D.O.S. process. This unique A. O. Smith metal fabricating idea has been creatively applied from customer prints to production run . . . on a wide variety of other products such as hollow steel propeller blades, structural air frame components, jet engine spacer rings and numerous other industrial parts and assemblies.

## here's how it works...



Blade pitch is accurately obtained through hydraulic press operation.

Finished blades, over 100 per turbine, are delivered to the customer, ready to be installed after simple machining on the root.

Write for Bulletin A-17-A describing the E.D.O.S. process . . . just one of the many ideas-processes from A. O. Smith, partner in your progress through creative mass production.

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# POINTS

THE QUESTION: **What Should an Engineer Learn and Unlearn to Become a Good Manager?**

**LAWRENCE A. APPLEY**
President
American Management Association

## "When an engineer becomes a manager

two specific and dramatic changes must take place in his thinking: He must think in terms of the direction of the efforts of people rather than the completion of engineering projects; he must realize that his progress as a manager is dependent upon the number of people whom he can successfully motivate rather than the number of projects which he personally can complete satisfactorily and on schedule.

"The engineer starts his life work as a specialist and he receives his promotions in accordance with his expertness in his specialty. When he becomes a manager, this whole situation changes. He is now a generalist. He is now appraised on his ability to identify and supervise specialists.

"To be a manager, the engineer must acquire a new set of principles, skills, and tools—those of management. These principles, skills, and tools do exist; a considerable body of management know-how has been accumulated, and more is being added to it every day.

"There are some things which an engineer must forget when he becomes a manager—the most important of which is the exactness and accurateness with which he has appraised the results of his work. He must now realize that he is dealing with human beings. Human qualities, potentials, and relationships are anything but exact and are constantly changing. Very broad and flexible allowances must be made. On the other hand, much more is to be expected of human beings than of material things, and the life of the manager is full of many more surprises than that of the engineer."

## "There is no science of business . . . .

All business decisions are based upon the interpretation of quantitative data, intuitive appraisals of unquantified information, consideration of the limitations imposed by law and by the action of human beings in cooperative, productive effort.

"The good engineer brings to the management process two enviable qualities: (1) an understanding of science and engineering upon which the application of industry rests; (2) a training in rigorous, analytical thinking which is often helpful in the solution of management problems. On the other hand, the engineer's interest in things and processes and his search for reasonable certainties are handicaps in the effective performance of management responsibilities in our present world.

"Thus I would argue that the engineer must acquire a knowledge of the methods of production, distribution and finance. He should understand as much as possible about himself, the nature of other human beings, and the environment—economic and political—in which he lives. In addition, a successful manager should possess the intellectual skill and resilience to deal with the novel situations presented to him by changes in the economic, social and technological circumstances."

**ELI SHAPIRO**
Professor of Finance
School of Industrial Management
Massachusetts Institute of Technology

# OF VIEW

**R. E. PATTISON**
Director of Engineering Training
International Business Machine Corp.

## "There are three broad areas . . .

of knowledge and skill which an effective engineering manager must possess: an understanding of people, a knowledge of the operational functions of his company, and skill in administering his engineering project.

"A manager must accomplish his project objectives through other individuals. It is therefore imperative that he understand basic human psychology and methods of stimulating desired responses in other individuals.

"The quality of the engineering which goes into a new product greatly affects the future profits of the company. In order to insure maximum profit, the engineering manager must have a clear understanding of the functions of the pertinent areas of the company, such as manufacturing, sales and service, and of his tremendous influence on their future operations.

"The engineering manager must also possess skill in administering his particular project. He must have skill in planning both the technical and non-technical phases of his project, as well as organizing an effective work force to achieve the technical objectives. He must apply all of his knowledge and understanding of people in the face-to-face direction of his project and insure that coordination with other functions of the company is accomplished at the proper time.

"Engineers, because of their training and experience, are well prepared to assimilate knowledge of the company organization and of the technical phases of administering the engineering project. They probably will, however, have to exert considerably more effort to comprehend the polyhedron we call 'man' and to thoughtfully and continually apply understanding of his daily activities."

## "Engineers are not all alike . . .

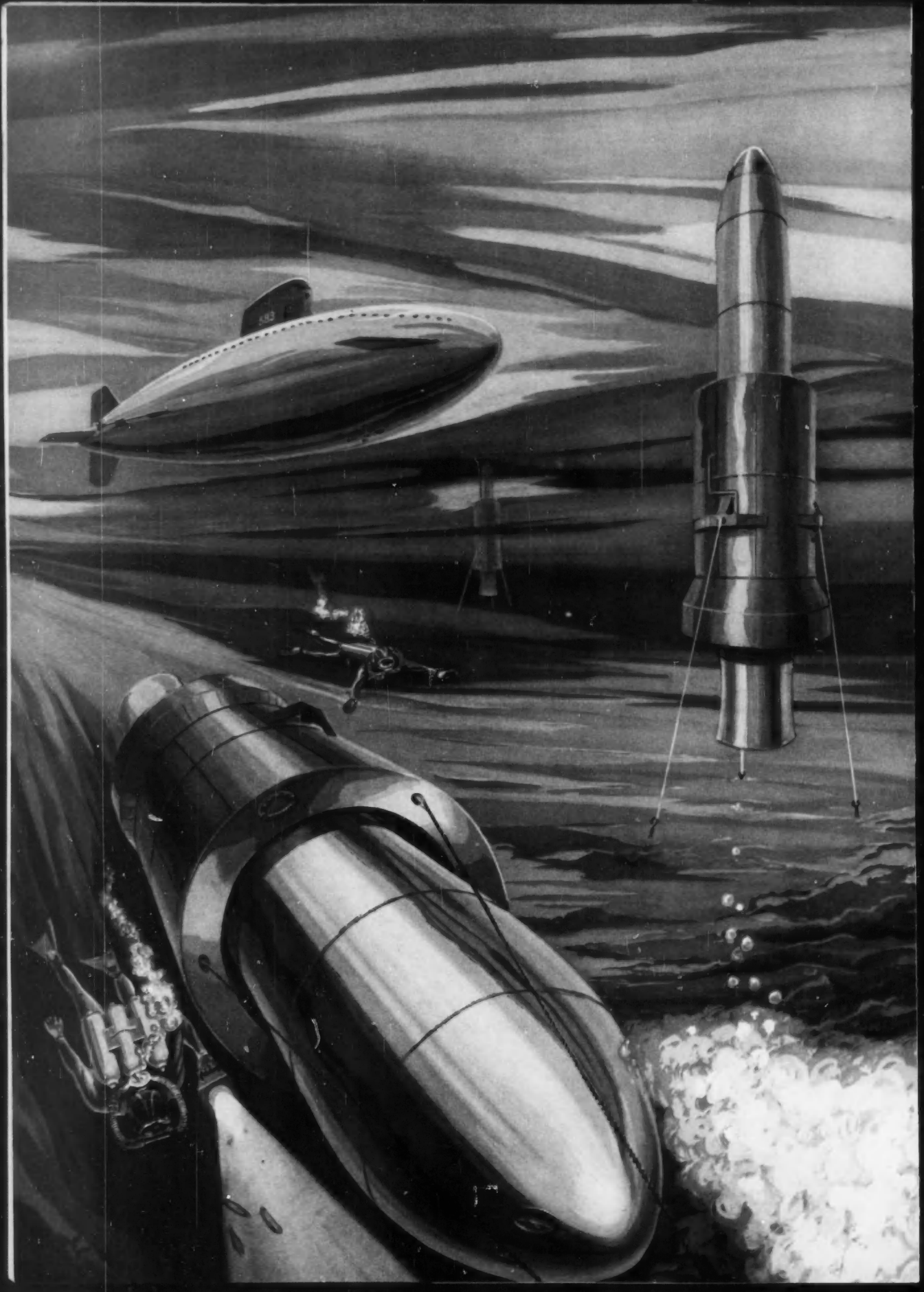
either as individual personalties or in the ways they think about the subjects that interest them. Some engineers make their best contribution by doing functional contributor work, while some should ultimately do managerial work. Remembering that the rewards at the end of *both* paths can be exceptional, the decision between them should be reached on the consideration of an individual's relative talent for the two kinds of work.

"Assuming that an engineer wants to become a manager, one of the first things he must learn is how to delegate. Surprisingly, this is not always easy to do. People must be allowed freedom in doing a job and even to make mistakes. Seeing people struggle with something the 'manager' is sure he could do better himself is agonizing but must often be endured.

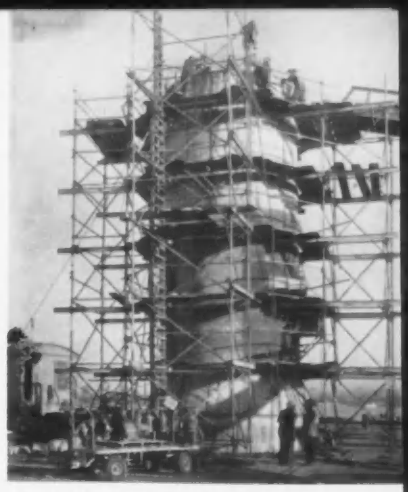
"As a manager, the engineer must develop an insight into the managerial and economic objectives of the company as a whole, acquire an understanding of the importance of programs other than his own, and maintain active cooperation with the other functions of the business.

"I think we can all remember instances when engineers acted as if they were on the side lines watching the rest of the team play the game. They sometimes discuss the policies and decisions that affect their business future in a very detached manner—very critically, but detached. As long as an engineer has this attitude and does not connect his actions and contributions with those of the other players in the game, maximum contribution cannot be expected from him; and, for just as long, he cannot become a successful manager."

**C. F. SAVAGE**
Consultant—Engineering Professional Relations
General Electric Co.



# PRODUCT PLANNING WITH POLARIS



*POLARIS LAUNCHING POD*

"Launching vehicle or pod under construction for Polaris test work probably is similar to equipment the Navy will use to fire its intermediate-range ballistic missile from under the water. After its release from a submarine, the pod's ballast tanks would control its depth and keep it floating upright in the water. Equipment in the pod would be remotely controlled from a parent submarine located some distance away. Suggestions also have been made for making the Polaris pods automatic so they could be sown like mines to fire hours later. The transporting submarine could then leave the vicinity and avoid any enemy action against the launching area."—*Aviation Week* Jan. 13.

**Waiting for an official release on how the Polaris will be launched, several engineering editors suggest their own how-to . . . and in the process illustrate the group approach to design.**

Product planning is a misunderstood term for a confusing process. When companies were small and products were few and simple, the process was so elementary that it was unofficial. But now products are very complex and production quantities are large. In many companies, product planning is looked on as a sales function, based on sales and service reports. In other companies, it means setting production quotas, or is the high-flown term for design or redesign. In still others, "PP" is the synonym for industrial design or styling.

Properly, it is an engineering function concerned with design, appearance and potential sales. Thus Sales, Purchasing and Production are involved, but the real planning must be done with an eye on basic engineering design. To illustrate the process, several engineers on the staff of PRODUCT ENGINEERING sat down one day in mid-January for a product-planning session. They chose as their subject "How to Launch *Polaris*," the Navy missile about which very little had been released, except that it is a solid-propellant IRBM to be launched by submarines on cities or military installations within 500-1500 miles. Indications are that it is 30 to 40 ft long.

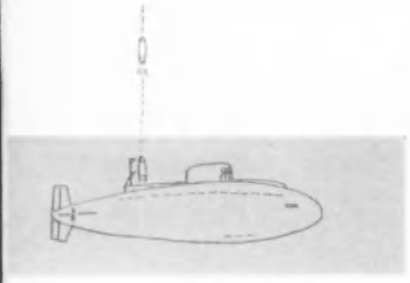
**STEP ONE—ANALYSIS OF THE PROBLEM.** This requires selection of arbitrary values for missing ones. Assumptions were: diameter about 5 ft, weight 20 to 22 tons, fins rudimentary, if any. High initial thrust resulting from solid propellant. Initial flight in air—vertical position. These were assumed, based on predecessor missiles similar in type, about which information is available.

**STEP TWO—STUDY OF POSSIBLE METHODS.** Four methods for launching such a missile occurred to the editors. They will be discussed individually, although all were developed before analysis of any.

**1. Vertical launch from submarine deck.** Requires setup of the missile on deck, possible with a hoist from a deck hangar similar to that developed for storage of helicopters or scouting planes on some submarines. Handling would be complex. Requires exact positioning of submarine and holding for a long period, during which it is vulnerable to attack. There would be difficulty with inertial-guidance system setting.

*HOW POLARIS MAY BE LAUNCHED*

Missiles, carried in a nuclear submarine similar to the new Albacore class, are jockeyed into launch position by frogmen with "electric tugs." Held in tubular launchers anchored to the bottom, the missiles are planted like a "mine field" and may be fired by time fuse, remote control or sonar.

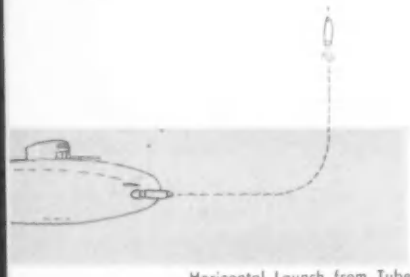


Vertical Launch from Deck

Solid propellant has high initial impulse, with consequent "kick" against deck. Greatest danger is possibility of propellant malfunction, causing explosion that would destroy the submarine. Also, submarine immediately reveals itself when missile is launched.

**2. Horizontal launch from tube.** Requires tube 5 ft dia, compared with present 18 to 21 in. (for torpedoes). Would require slow-velocity ejection from tube by conventional means, with 90° change of direction and vertical firing under limited control. This method was considered the only feasible one by former Navy officers consulted, because firing officer could report effectiveness of launch. Danger of missile jamming in tube considerable—a common occurrence with torpedoes.

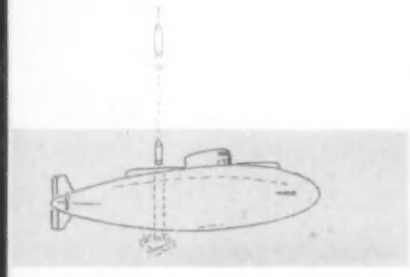
Here, however, is a basic principle in product planning—that some intelligent ignorance helps. Non-Navy engineers, unhampered by knowledge of conventional procedures and problems, rejected this method as too complex and dangerous, with too low an accuracy and reliability, and with too much danger of discovery—requires a second guidance system and controls for water operation.



Horizontal Launch from Tube

**3. Launch vertically from a special submarine.** This is possible, and available Congressional testimony (see "Comments on Polaris," this page) and newspaper reports favor it eventually. Assume a tube open at both ends, so it functions merely as a guide tube, like the bazooka. Mention in Congressional hearings of planned submarines, 33 ft dia, supports this theory, if *Polaris* is 30 ft long. Several tubes in a nest are possible. Initial impulse could come from compressed air. Problems: Sudden loss of weight in launching, danger of loss of ship from explosion in malfunction, danger of discovery; necessity for water 125 to 150 ft deep; large structures running through machinery spaces in crowded subs.

(Clay Blair, Jr., suggests this method in *The Saturday Evening Post* for Feb. 22, except that he adds a canister which is dropped when the Polaris "lights off" in air. This is a sure way to reveal launching area.)



Vertical Launch from Integral Tube

**4. Launch from a separate mined platform.** Missiles could be carried in the submarine, or as a deck load, and floated off by a buoyant tube which would also act as a support and guide for launching. Handling would be done by deck crane (slow and clumsy) or by frogmen utilizing underwater tugs, battery-operated, of the "electric mule" type now in use. Weight of the missile could be taken by a tube that could be trimmed by cartridge or shipboard pump to necessary buoyancy. Towing and anchor cables permit handling and positioning without damage to missile. This jacket would also be a launcher from which the missile would be fired. Thus depth of water could be greater and launch could be from a more stable base less prone to tidal action. Firing could be done by remote control, time setting, sonar, radar or other electrical, electronic, mechanical, sonic or shock device. A field of missiles could be planted, timed for simultaneous or delayed launch. Detection of the submarine would be minimized since it could be hundreds or thousands of miles from launch scene at blast-off.

**STEP THREE–PICTURE THE DESIGN.** Ideas at this point were dictated to an artist, who produced the planning sketch from which our lead picture was painted. Accuracy of the analysis is indicated by release from Mare Island Navy Yard of the photograph here reproduced showing test equipment for the missile. (It may also be proved eventually to be a faulty analysis–which also happens in any product planning.

This procedure indicates, incidentally, how bits and pieces of classified information, incautiously released as were the words and photo mentioned above, can be pieced together to "break" a supposedly secret story. Adequate secrecy for new weapons in the hardware stage can be attained only by releasing *no information whatsoever*, an extremely difficult thing in a democracy during a peacetime election year. And perhaps inadvisable because "secrecy" usually keeps only the public—not the enemy—in the dark.

### Comments on the Polaris

- Thomas S. Gates, Secretary of the Navy—". . . The missile itself features simplicity, reliability and instant readiness because it employs solid rather than liquid propellants. The base—the atomic submarine carries missiles in quantity to launch points anywhere in all the oceans."
- Admiral Burke, Chief of Naval Operations—"The system . . . must be able to launch from fully submerged platforms."
- Admiral Raborn, Dir., Special Projects Office—" . . . all our basic research problems have been solved, and what we have now is essentially an engineering job."
- Hon. John F. Baldwin, Congressman from California—"Mare Island is in the process of constructing a launching cylinder that will be used in tests of the Polaris."

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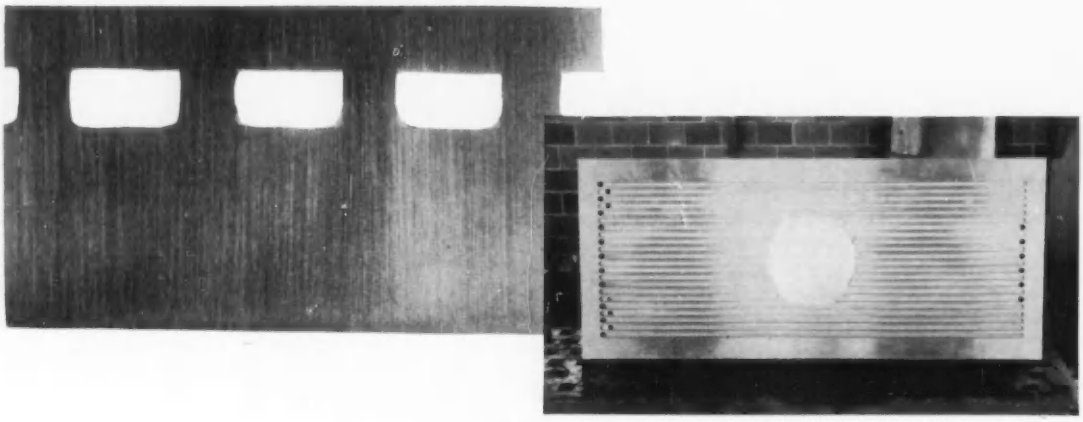
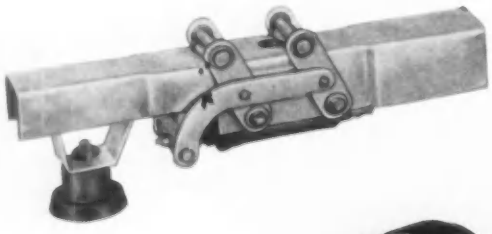
# SIGNIFICANT PARTS

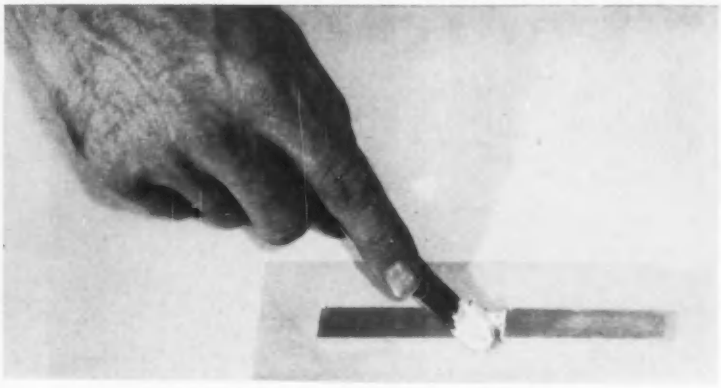


**Channeled-and-clad plate has circulating passages . . .** for heating or cooling medium that are machined in before bonding of top plate. Connections are made to outside lines through drilled and tapped holes. Plate may be formed, welded and further machined into cylindrical and other shapes after cladding. Vacuum cladding process used permits even wider choice of base and top plate materials than regular roll-bonding procedure. Channel cross-sections may range in depth from ¼ to 1 in., in width from ½ to 1½ in. Plate lengths so far have been to 220 in., 60 in. wide. Where cladding and base materials are in stock and dimensions are in the range of manufacturing experience, delivery within 4 mo after approval of specifications. **Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago 4.**

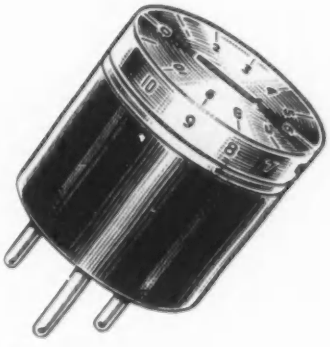


**Surge mechanism stops towed vehicles . . .** when inertia of moving trailer actuates brakes. The device (at left in illustration) is part of a brake system smaller than those normally used on autos. The brake itself, 7 in. in dia and with 31 sq in. of lining surface, is actuated by standard hydraulic or mechanical means. Application is expected to small trailers, road sweepers, midget cars, garden mowers and tractors, and materials handling equipment. Brake is designed for 8, 9 and 10-in. rims. **Dico Co., Des Moines, Iowa.**

# MATERIALS · EQUIPMENT



**Electrical conductivity of epoxy adhesives . . .**
compares with that of metal conductors. Epoxies are recommended where soldering is impractical. They are supplied in paste form and can be cured at room temperature, 120 F or 300 F, depending on type. Usable temperature range is −65 F to 500 F. Bond strength above 2000 psi is claimed with metals, plastics, glass, ceramics. Thinned out, these adhesives can be used as conductive surface coatings. One-component adhesive is $39 per lb; two-component paste needs catalyst at $3 per lb. Introductory kit is $10. Delivery is from stock. **Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.**



**Potentiometer with dial . . .**
is calibrated twice, radially for side reading and on end for end reading. It has equal graduations from 0 to 10 in the 300°-winding angle of the potentiometer. Scribe line on base acts as an index. Brush is phased so that zero graduation on dial is in line with scribe line at 0° rotation. Terminals are located on a standard 0.1 in. grid used in printed circuitry, with terminal numbers clearly marked. For resistances to 20 k ohm, over-all length is ½ in.; for resistances to 100 k ohm over-all length is ⅝ in.; for resistances to 250 k ohm, over-all length is ¾ in. Wattage dissipation is 2 w at 104 F. Starting and running torque is 1 in.-oz nominal. Units are housed in anodized aluminum cases with gold flashed terminals. The subminiature potentiometer, ¼ in. dia, is suitable for printed circuits. Price is $15 a unit; delivery is from 4-6 wk. **Waters Mfg., Inc., Boston Post Rd., Wayland, Mass.**

**Microminiature potentiometers . . .**
only ¼ in. dia, and rated at ¼ w are designed for operation under extremes of heat, cold, humidity, vibration and shock. Available for stud or lead mounting. Wound with low-temperature-coefficient wire. Potentiometers feature anodized aluminum cases, stainless steel screwdriver shafts and Mylar and Teflon insulation. Weigh 0.03 oz each. Standard resistance ratings are 500 to 10,000 ohm. In small quantities, $6.50 each; delivery about 3 wk. **Miniature Electronic Components Corp., Holbrook, Mass.**

**Reinforced epoxy pipe . . .**
is now being manufactured in 2 to 12 in. dia by a process employing interwoven fiberglass filaments impregnated with epoxy resins and heat cured. Pipe comes rigid 20-ft lengths with ends plain, bell-and-spigot or flanged. Other lengths, and dia to 40 in., are available on special order. Standard are two series: one with a nominal working pressure of 250 psi and another rated at 500 psi. Each has a 10:1 safety factor. Tensile strength is 80,000 psi circumferential and 40,000 longitudinal. Priced at $2.45 to $34.50 per lineal ft, depending on size and working pressure. Delivery in 30 days; 60-90 days on dia over 6 in. **Amercoat Corp., 4809 Firestone Blvd., South Gate, Calif.**

**Inorganic insulating material compares with still air . . .**
in thermal conductivity, withstanding 1300 F long-time and up to 5000 F for seconds. Material is moldable and may be metal clad for resistance to oil and other harmful fluids or laminated (with metal or plastics). Material is 25% heavier than asbestos but thickness required is half or less. Expected to be relatively more expensive than existing insulating materials. **Johns-Manville Corp., Manville, N. J.**

# BEAVER
## BALL SCREWS

Successor to the Acme screw drive and preferred in many applications to hydraulic and pneumatic systems. Guaranteed 90% efficient in converting rotary twist to linear push (or vice versa). Employs a stream of precision balls and ground lead to eliminate drag and wear in delicate instruments, aircraft, machine tools, massive wind tunnel jacks, etc. For horizontal and vertical actions, indexing, inching and traversing. Consultation and engineering service available. Write for literature.

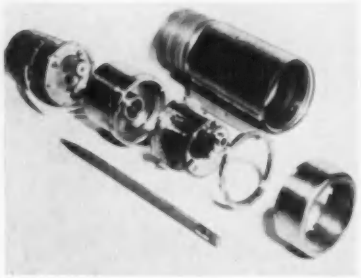
• EXTREME ACCURATE POSITIONING • NO BACKLASH • RAPID START • ANY DIAMETER OR TRAVEL •

Beaver Precision Products INC.
CLAWSON, MICH.


SIGNIFICANT PARTS
MATERIALS
EQUIPMENT . . .

### Variable speed fhp motor . . .

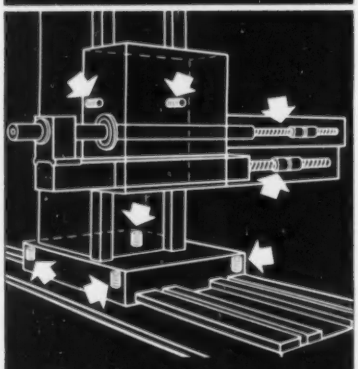
is available in two standard models; one is rated 0.5 in.-oz on 115 v dc, 1800 rpm, 10 w, the other is rated 1.0 in.-oz on 115 v dc, 1800 rpm, 15 w, as well as 24 to 115 v with speeds from 900 to 3600 rpm. The motor is a shunt-wound dc unit from which variable-speed drive can be obtained by varying armature voltage. Will also be offered with gear reductions in standard ratios from 3:1 to 3600:1 with rating the same as company's standard gear motors. **Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., 125 Armory St., Boston.**



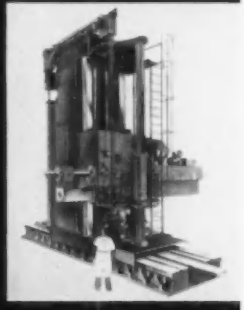
### Binary timer . . .

provides 128 binary counts at the rate of 1 per sec continuously. It is an integrated design, composed of a commutator and brush assembly plus low-inertia, gold-plated code drums driven by a 28-v dc chronometric motor in a 2½ in. dia case. Weight is 2.3 lb. Unit is hermetically sealed, RF filtered and meets military specs. During each data frame or second of time a synchronizing commutator pulse occurs, followed by an identifying eight-bit binary encoded train of pulse. The sync pulse initiates the second and the binary coding identifies it. Repetitive cycles of the 128 bits can be recognized by a simple counter or special sync-pulse coding. This serialized counting technique codifies the time base in control systems for simplifying data reduction. **Instrument Development Laboratories, Inc., 67 Mechanic St., Attleboro, Mass.**


# Versatility!



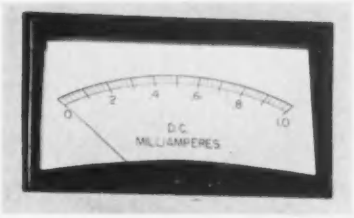
THE WORLD'S LARGEST FLOOR TYPE HORIZONTAL BORING - DRILLING - MILLING MACHINE USES 6 BEAVER BALL SCREWS FOR POSITION CLAMPING AND 2 FOR SPINDLE FEED

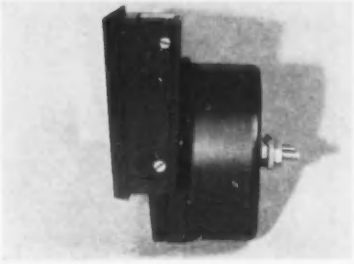


The same accurate positioning, rigidity and freedom from backlash essential in this huge Giddings and Lewis Model 1210-FUAR with 10″ spindle is available to you for improving the efficiency of your equipment. Consultation and engineering service. Write for literature.

Beaver Precision Products INC.
CLAWSON, MICH.

SIGNIFICANT PARTS
MATERIALS
EQUIPMENT . . .



**Tilted meter face . . .**
results in better visibility and reduced error (held to about 10%). Such errors are caused in D'Arsonval movements by magnetic mounting panels. Magnet pole pieces are in back of the panel, not on the same plane with it. Meter exposes only its indicating area when installed in a panel. Its face is flat, and about one-third of the round barrel, enclosing the meter movements, extends back of and below the rectangular dial section. The movement, face and pointer are tilted back 6° from vertical front of meter. Dial section measures 5 x 2⅞ in., depth from flange to the end of barrel is 2¼ in. Available in any range of sensitivity from 0 to 5 microamp to 0 to 50 amp. **Assembly Products, Inc., Chesterland, Ohio.**

**Filtering elements . . .**
of either sintered bronze or 316 stainless steel are offered for 5000-psi max operating pressure in temperature limits of —60 to 450 F. Bronze elements are available in 5-12, 12-25, 25-50, 50-125 or 150-200 microns; stainless steel elements come in 5-7, 7-10 and 10-13 microns. Body of are in back of the panel, not on the same filter, has brass or 303 stainless, ⅛, ¼, ⅜ or ½-in. female pipe connections and permits replacement of filtering element. **Hoke, 136 S. Dean St., Englewood, N. J.**


# "POP"® RIVETS

## can probably save you money . . .

***Even if your present fasteners are free!***

**Greater Design Flexibility**
No need for access to both sides.



**High Clinching Action**
Exerts as high as 600 pounds squeeze between parts.



**Wide Grip Range**
Same length "POP" Rivet holds tight through thick or thin.

**Vibration Proof**
"POP" Rivets cannot back out or become loose. No lock washers or nuts required.

**Low Head Profile**
Where space is important, "POP" Rivets' minimum head height is the answer.

**Less Critical Hole Diameter**
Designer wants holes tight, production wants holes larger. "POP" Rivets make both happy.

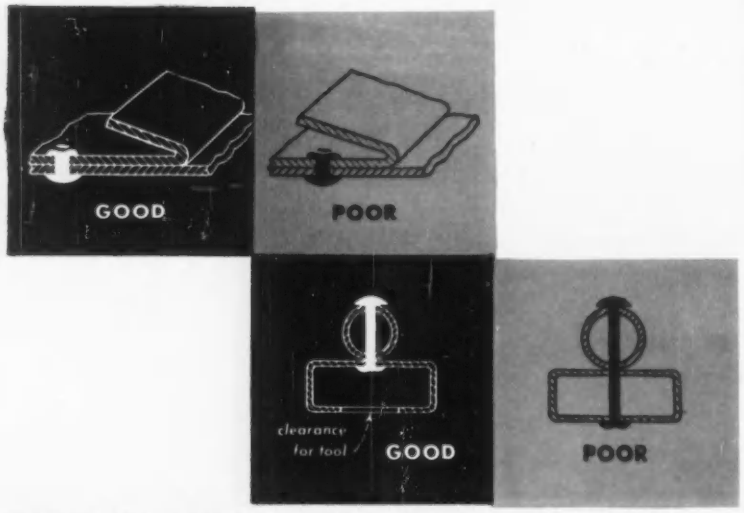
**Least Back-Up Space**
Strong, high grip "POP" Rivets need only enough back-up space to provide room for set head.

When buying fasteners, do you figure the *installed costs?* A fastener considered alone may cost very little but be very expensive by the time it's installed and becomes part of a finished product.

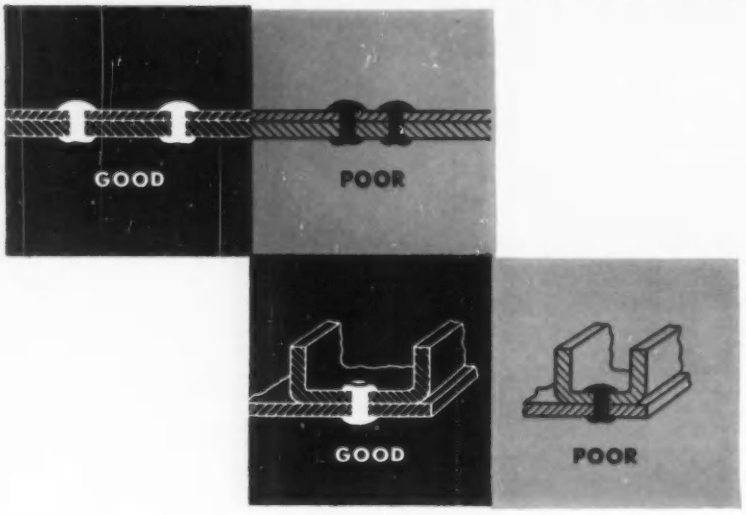
"POP" Rivets afford greater flexibility in product design. Often operations can be eliminated, assembly costs reduced, and speed of fastening increased.

Many users find high strength "POP" Rivets the most efficient and economical fastener for their product. Investigate its use in your application. Perhaps you too can enjoy the many advantages "POP" Rivets have to offer. Write us today.

## "POP" RIVET
**DIVISION**
**UNITED SHOE MACHINERY CORPORATION**
**West Medway, Mass.**




# TIPS ON USING RIVETS




*A short design course guaranteed to save a lot of grief—and money!*

You could memorize these and thousands more design tips on the best use of rivets—but don't! Much simpler to call on Milford for the right answers to all your riveting design and application problems. Saves time and money, too. Full-tubular, semi-tubular, split, cutlery, decorative—Milford makes them all from any metal or alloy that can be cold-formed, then adds a wide variety of platings and finishes.

To improve product appearance and strength
. . . to take full advantage of automatic assembly
. . . to cut delivery time and production costs
*—get in touch with Milford first!*

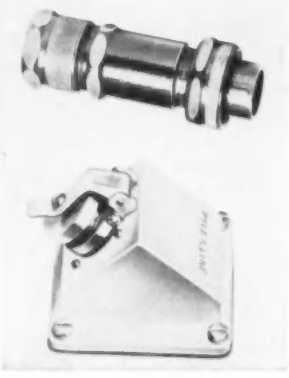
THE MILFORD RIVET

**MILFORD RIVET & MACHINE CO.**

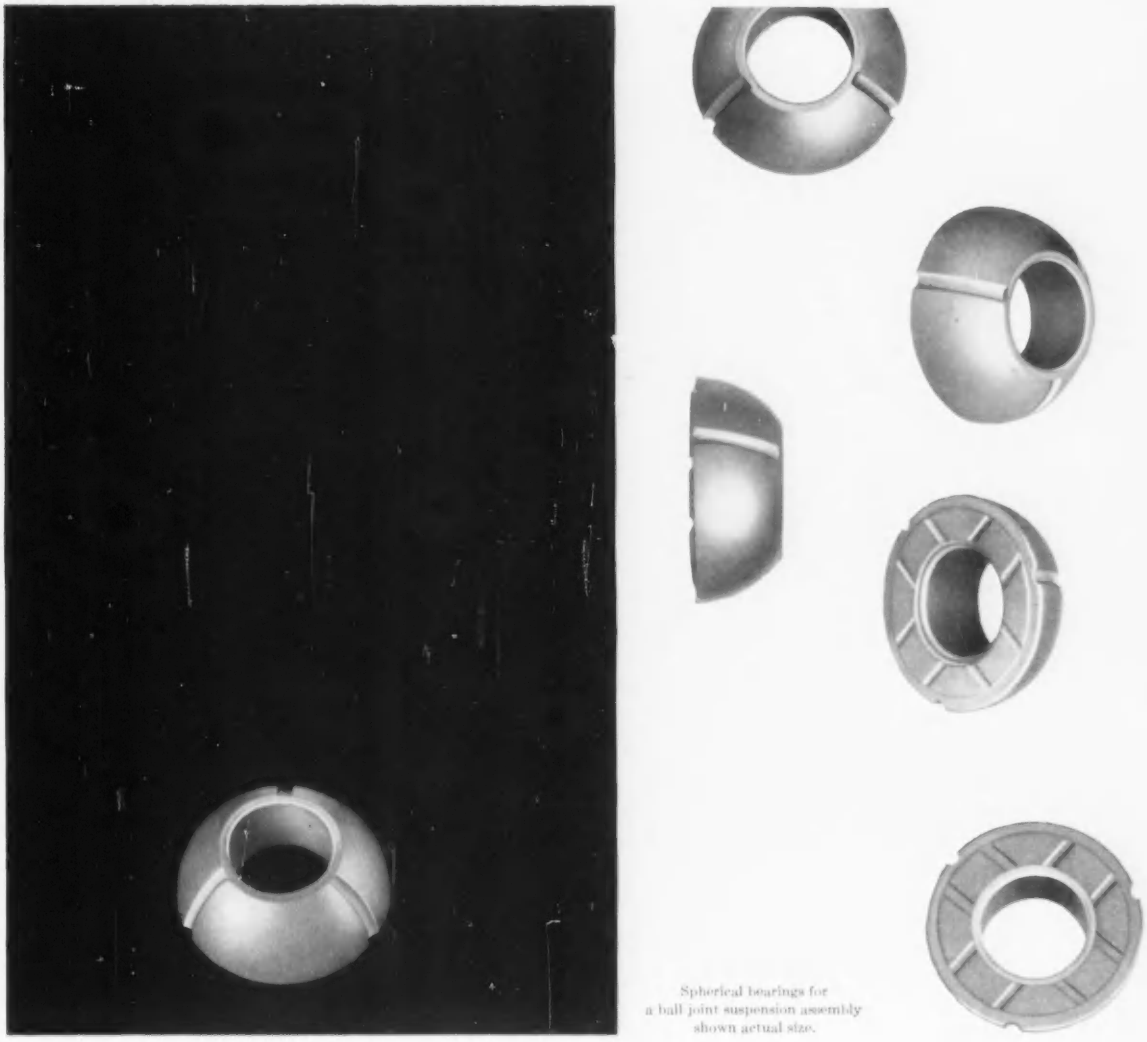
MILFORD, CONNECTICUT • HATBORO, PENNSYLVANIA
ELYRIA, OHIO • AURORA, ILLINOIS • NORWALK, CALIF.


## SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

**12-position stepping relay . . .** uses a printed-circuit board for switching currents up to 250 milliamp. Relay can be furnished for ac-or-dc operation. Operates on 3 w dc or 20 v-amp ac. Relay is normally pulse-operated, but the dc coil withstands 3 w continuously. Ac relay must be pulse-operated. An armature-driven pawl operates a ratchet to drive a movable arm in 30° steps over 12 non-shorting printed circuit strips. **Potter & Brumfield, Inc., Sub. of American Machine & Foundry Co., Princeton, Ind.**



**Plugs and receptacles . . .** designed to meet severe industrial environments are UL-listed in NEC for interrupting circuits of 30, 60, 100 and 200 amp, 600 v ac. All have a double lead-plug coupling thread. Threaded housings can be furnished with dust cap or a hinged spring flap cover. Interchangeability of components permits many assembly combinations, including a choice of contact-configuration inserts ranging from 4 to 100 poles for power, control and electronic circuits. Has silicone sandwich-insulation construction, is light and compact. **Pyle-National Co., 1334 N. Kostner Ave., Chicago 51.**



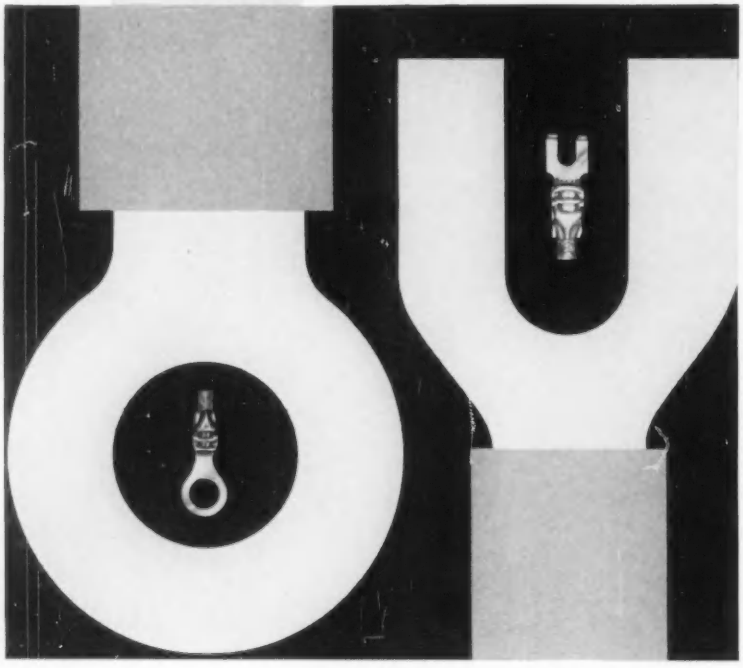
Spherical bearings for a ball joint suspension assembly shown actual size.

# What about *wear* with sintered metal parts?

Resistance to wear is an outstanding characteristic of the ball joint suspension bearings shown here. Moraine Products makes them from sintered metals, in quantity, in one operation without machining, and to closer-than-ever tolerances. For this application, as for so many others, long-wearing sintered metal parts by Moraine Products have proved themselves to be the modern, economical answer.

Moraine Products also produces: Moraine Power Brakes • Delco Hydraulic brake fluids, brake assemblies, master cylinders, wheel cylinders, and parts • Moraine friction materials • Moraine-400 and M-100 automotive engine bearings • self-lubricating bearings and porous metal filters • rolled bronze and bi-metal bushings.

**Moraine Products**
Division of General Motors, Dayton, Ohio



For perfect insulated termination . . .

faster . . . specify the A-MP®

**PRE-INSULATED DIAMOND GRIP** terminal

If you need terminals with bonded insulation—if you need corrosion resistance and wire-supporting vibration resistance—you have it instantly in one closure of A-MP's matched crimping tool. Only one lightning-quick step for crimp-sure optimum strength and conductivity. A-MP PRE-INSULATED DIAMOND GRIP Terminals exceed the most rigid military and commercial specifications.

A-MP's precision-engineered terminals are matched to precision-engineered tools that make an exact crimp every time, never too little, never too much. Perfect terminations—whether you need one or a million. No great operating skill necessary. A-MP's match-mated tooling does all the work and at lower installed cost than other methods of wire termination. Wire range is from No. 26 to No. 10.

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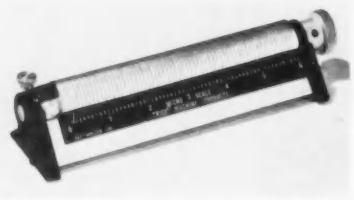
## SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

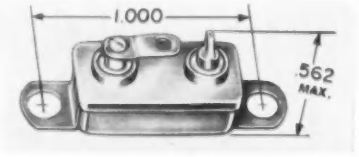


### Tool that speeds settings . . .

of drafting and other instruments permits setting dividers to three-place-decimal accuracy without gage blocks or other standards. Tool has a direct-reading scale and graduated dial, calibrated in 0.001-in. increments from 0 to 6, 12, 18 or 24 in. Turning a knurled knob moves a helical scribed line on the barrel to provide the two fixed points for layout-instrument settings. **Trico Machine Products Corp., 2654 Grand Ave., Cleveland 4.**

### Adhesive-back rubber parts . . .

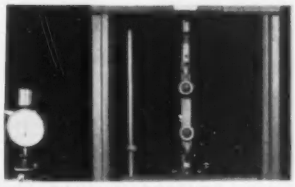
eliminate cementing at the point of assembly and adhere well to all surfaces. A wet-type surface, one of two offered, is covered with holland cloth; the operator peels off the protective covering before placing the part in position. The dry-type cemented surface is moistened with a solvent before use. Cost is said to be slightly more than nonadhesive-backed parts. **Mechanical Rubber Products Co., 35 Vail Rd., Warwick, N. Y.**



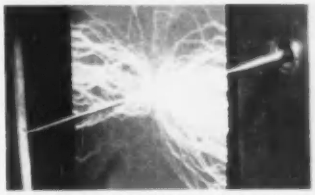

### Miniature sensitive thermostat . . .

is also hermetically sealed, temperature can be set either by the user or at the factory. Thermostat has inherent sensitivity of less than 1°F. Temperature changes expand or contract the stainless steel outer shell that actuates inner assembly to make or break totally enclosed contacts. Electrical terminals are isolated from ground. Operates in —65 to 220 F. Switch can be adjusted by an integral adjusting screw over a —20-to-200-F range. Rated 2.5 amp, 115 v ac and 2 amp, 28 v dc; 20 megohm insulation resistance. Unit shows no resonant frequencies between 5 and 500 cps vibration. Overall size of the lightweight thermostat is 1.25 x 0.562 x 0.401 in. **Fenwal, Inc., Pleasant St., Ashland, Mass.**

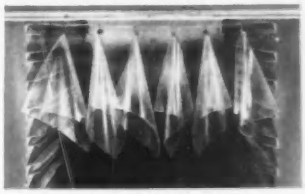
**"MYLAR"** *offers a unique combination of properties valuable for electrical design*



**HIGH TENSILE STRENGTH.** "Mylar" is the strongest plastic film. Instron tester shows an average strength of 20,000 lbs. psi.



**HIGH DIELECTRIC STRENGTH.** Average of 4,000 volts per mil . . . average power factor of 0.003 at 60 cycles . . . dielectric constant above 3.0 at 72°F., 1,000 cycles.



**THERMAL STABILITY.** Tests prove "Mylar" has an effective operating range, -80°F. to 300°F. . . . won't brittle with age.

# Here's why IBM introduced magnetic tape made with MYLAR for its data processing equipment

**PROBLEM:** International Business Machines Corporation wanted to increase the humidity and temperature range of magnetic tape used in its data-processing equipment. IBM was looking for a magnetic tape that maintained a relatively stable dimension through a wider range of atmospheric conditions.

**SOLUTION:** After conducting field tests over a period of 14 months, in conjunction with its own environmental test program on data-processing machines, IBM introduced magnetic tape using Du Pont "Mylar"* polyester film as the base.

**RESULTS:** Magnetic tape made with "Mylar", reports IBM, has good dimensional stability. This stability reduces the need for critically controlling temperature and humidity in recording or storage areas.

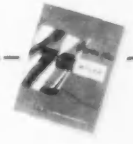
**HOW CAN "MYLAR" HELP YOU?** No matter what product you make, it will pay you to investigate the unique opportunities offered by "Mylar" . . . opportunities to speed up production, improve performance or cut costs. For dramatic proof through successful applications of "Mylar", send today for a copy of our new booklet.

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT **MYLAR**® POLYESTER FILM

*"MYLAR" *is Du Pont's registered trademark for its brand of polyester film.*



E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room PE-3, Wilmington 98, Del.

☐ Please send your booklet outlining advantages of magnetic recording tape made with "Mylar".

☐ Please send your booklet listing properties, applications and types of "Mylar" available. (MB-11)

Application _____
Name _____ Title _____
Company _____
Address _____
City _____ State _____

*(Advertisement)*

# COLD HEADED FASTENERS COST LESS

**and usually give better performance**

The designer need not be restricted to standard fastener sizes when they do not meet the requirements of his application. It is often much less expensive to specify a rivet, nail, screw, pin or stud to meet the task exactly as the application requires, than it is to compromise its function for the sake of "standards." In this regard, we offer the equally important advantages of flexibility according to our customers' design changes and production by high speed, quantity techniques. While there is nothing mysterious about the cold heading process, experience has proved it to be of inestimable value for getting maximum quality and output at a minimum cost. While the really spectacular advantages in cost show up in runs of several thousand pieces, we are also able to take care of your short run requirements. We welcome and expect manufacturers to come to us for advice and assistance concerning their fastener problems.

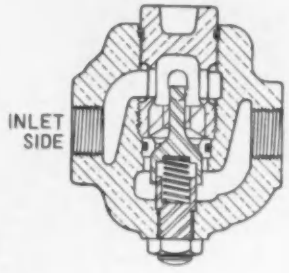
Given complete specifications, including a drawing and an idea of the application, we can quickly tell you whether or not it will be advantageous to have your fastener or part JOB-DESIGNED by HASSALL. The remaining important aspect of our service to you is the ability to get into production quickly and make prompt shipment.

Write for a copy of our new booklet, "What the Designer Should Know about Cold Heading."

**John Hassall, Inc.**

**P. O. Box 2233**
**Westbury, Long Island, N. Y.**
***Manufacturers Since 1850***

## SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .




### Spring-loaded check valves . . .

especially designed for 4000-psi oil or raw-water service are available from ¼ to 2 in. NPT. Valves have inverted seats. Downward flow through seat ring, and past the check located below it, is said to keep sealing surfaces free of foreign particles that might cause leaks. Flow area through valve is equal to or greater than transverse area of nominal size, extra-heavy pipe. Valve body and seat retainer are Navy M bronze; seal stem and guide are stainless, spring is Inconel. **Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.**

### Photo-recording paper . . .

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# NEW LITERATURE

## Five Books on Automation

Although it is not pointed out nearly often enough, automation has more than just an exciting present and science-fiction future. It also has a history, and a highly productive one at that.

When America became a nation on wheels, continuous automatically produced petroleum products began their never-ending flow. Batch production of chemicals, drugs, certain foods and beverages, as well as other products, has given way to today's "onstream" techniques. Metal-producing industries are probably among the most active material suppliers trying to overcome limitations of procedures, largely unchanged since early in this century.

Perhaps the most advanced manufacturers in applying automation to the production of parts are the molders of plastic and metal components. Here, too, a type of continuous flow is the basic procedure. The sectors of industry most in the automation headlines today are essentially those that find it most difficult—if not impossible—to apply continuous processing. These processes probably have always required the greatest proportion of, and the most skilled, hand work. More often than not, the problem of automatic control in these industries can be summarized as the problem of determining and controlling the position and speed of a shaft. Here, feedback-based control of output is a must; human monitors are not reliable enough.

A byproduct of automation has been a flood of books, as this review of five volumes attests. All were issued in the last three months or so. These studies, though useful in their own ways, reflect the continuing inadequacy of the usual reasons for automating production. Our technological breakthroughs are almost always viewed as means of "cutting costs," "overcoming rising labor rates," "increasing and improving production." Seldom do we hear that a process has been automated because it was best done by machine, either for reasons of human limitations or because of the desirability of freeing humans from drudgery for more creative pursuits.

Perhaps it is because improvements in productive efficiency are so seldom based on these more socially aware precepts that we generally have serious dislocations in the lives of the people, communities and industries concerned. And such dislocations, however temporary, can hardly be considered a stabilizing influence on general economic conditions.

There is almost no objective productive process in which we are presently engaged —or likely to be in the foreseeable future— that cannot be automatically controlled. However, it is just as important that automation be desirable sociologically.

When five out of six books in half as many months concern themselves with other than the technical aspects of automation, it is proof that concern for the sociological question is growing. Perhaps these studies also show we are aware of another turning point in the techniques of satisfying man's needs. As the nineteenth century saw the great metamorphosis effected by the mechanization and heat-powering of production, the twentieth is witnessing the installation of automatic systematization and control.

Indications of the concern for these critical historical questions by engineers, management, sociologists, other specialists and special interests are good.

**TOWARD THE AUTOMATIC FACTORY,** by Charles R. Walker, provides a rich source of reactions of designers, builders and, in particular, the operators of the first continuous seamless-pipe mill in the US, completed in 1949, at Lorain, Ohio. The study is replete with quoted comments on the changes in working conditions, pay, and job security, brought about by the mill's construction and use. Machine designers should find many of the comments of significance in their own work, no matter how different their industry may be. The author has written other books and articles on social, human and labor problems in industry and has served in this field for Yale, Harvard, the federal government and the UN. *Published by Yale University Press, New Haven, Conn.,* 5¼x8¼, 232 *pp.* $5.

**MEN, STEEL AND TECHNICAL CHANGE** is the first of a series of pamphlets on problems of progress in industry, prepared by the Industrial Research Section, Dept. of Social Science, U. of Liverpool, England. The series is intended to keep both labor and management officials abreast of the latest scientific and sociological studies published on the effects of automation. Again, like the Walker study described above, this report describes technological changes in the steel industry. In this case the study extends over a much longer period. The English company involved began in 1851 as a nail manufacturer, and today has become a large integrated steel works employing more than 9000. The reaction to the construction of a continuous strip mill and cold mill on the part of management, workers and their unions are discussed, and statistical reports of opinion presented. *Published by Dept. of Scientific & Industrial Research, Charles House, 5-11 Regent St., London, S.W. 1.* 5¼x8¼, 36 *pp.* $0.36.

**AUTOMATION AND MANAGEMENT,** by James R. Bright, associate professor of Business Administration, Harvard Business School, is not as concerned with analysis of the implications of automation for management as it is with detailed and extensive reporting of the actual experiences of management in applying and administering all phases of automatic control. The book is divided into three parts: (1) Nature of Automatic Manufacturing; (2) Experiences with Automation; (3) Critical Areas of Automation. Several appendices contain information from government sources, historical data, and examples of paperwork systems involved in automation. *Published by Div. of Research, Harvard Business School, Soldiers Field, Boston 63.* 9x11¼, 270 *pp.* $10.

**MAN AND AUTOMATION** is by L. Landon Goodman, an engineer with honors in both the mechanical and electrical fields. His book, in a paperbound, widely circulated edition, is directed to the layman; even its first section, devoted to technical aspects of automation, may be of interest to the technical reader, however, particularly for coverage of industries other than his own—especially if he is interested in the development of automatic control abroad. Mr. Goodman's second section, concerned with social, economic and other effects of automation is ambitious—the demands automation places on technological education are considered. Still, this author, too, evades some of the basic social issues mentioned above. *Published by Penguin Books, Inc., 3300 Clipper Mill Road, Baltimore 11.* 4¼x7¼, 286 *pp.* $0.85.

**AUTOMATION IN PRACTICE,** by S. E. Rusinoff, professor of Mechanical Engineering, Illinois Institute of Technology, is mainly a categorized description of the main techniques, equipment and fields of application of automatic control. Pneumatic, hydraulic, electrical and electronic devices are all discussed, and the automatic control of materials handling, assembly, metal production and metalworking considered. *Published by American Technical Society, 848 E. 58th St., Chicago 37.* 5¼x8¼, 261 *pp,* $6.50 —JK

# Can You Call a Man a "Failure" at Thirty?

*Men who think that success is only a matter of "a few years" are failures . . . however young they are!*

How often have you heard some young man in business say, "I'll admit the job I have now isn't much but, after all, I'm only in my twenties."

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This *mistaken* idea that success comes automatically with time is easy to understand. Promotions do come regularly and effortlessly to young men of promise. *But* the day arrives, often abruptly, when that promise must be *fulfilled*. Native ability and intelligence can carry a man only to the mid-way point in business—beyond that he must *prove* his capacity to justify a position of executive responsibility. That calls for a practical, working knowledge of business fundamentals.

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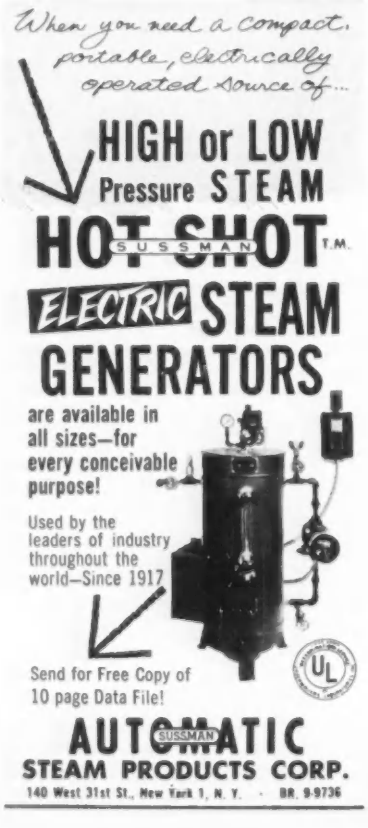
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# Publisher's Postscript...

# our INDEX is ready

We have long known that an annual index is essential to some subscribers and not to others. Libraries, schools, and those individual subscribers who bind volumes have definite use for it. We have, therefore, customarily bound it in the December issue as some eight editorial pages, and have made extra copies available to those who wished the index alone.

But now the index reflects our change to weekly frequency last September. It is twice as big as it has been, is expected to double again. The author's index is 50% larger, showing the effects of article condensation as well as increased pages.

There are many new index headings, and others are lengthened: "Applied Mechanics" is up 35%, "Bearings" 50%, "Engineering Administration" 400%. Industrial Design" and "Government" and "Missiles" have been added, "Instrumentation" and "Human Engineering" and "Plastics" more than doubled in length, "Product Development" and "Research" quadrupled, and so on.

If published in the magazine, this would replace some 16 pages of other editorial material, twice that hereafter. Those subscribers who do not need the index, or who want it separately, would thus lose a considerable amount of other material.

Thus the index is now a separate pamphlet, and is being distributed on request, as announced in PRODUCT ENGINEERING for Jan. 27 and Feb. 17. Requests should be addressed to K. Kane, Reader Service, Product Engineering, 330 W. 42nd St., New York 36, N. Y.

Included also are index of articles in the annual Design Digest Issue (Mid-October) and a list of special reports available for purchase.

—AH

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# 74 for your information (personal)

## Winding up a current

The "new look" in wind power plants, long predicted (*PE*—Nov. 4, '57, p. 5), has now arrived. Automatic Power, Inc., Houston 3, Tex., has a 6 kw power package, complete with wind generator, battery bank, and standby Nordberg Power Chief diesel, that operates on a fully automatic cycle and "has the capacity to handle three or four average homes." It will work at wind velocities as low as 6 mph, but does not achieve full output until wind reaches 20 mph. (This explains batteries, and diesel generator for recharging them.)

## For a quick pick-up

No, there's no sure cure for a hangover. But, if you're tired of scrambling under the furniture to pick up "lost" cuff links, and your wife is tired of climbing on the sink to reach the grocery shelves, there's a host of new devices that may solve the problem. A "grab-all" extension arm will retrieve packages from high-up shelves. A dual scoop, operated like a pair of chopsticks, will clean up after your dog—or pick up leaves and pine cones. There are magnet-tipped and point-tipped canes. The fact that there are so many might indicate the field is still wide open for a new one—a super-duper combination job. Maybe it's an idea for R&D (see next page).

## This blow-up erects homes

Not only are they building rubber buildings these days (*PE*—Jan.20, p. 8); but they're putting frame houses up with rubber bags. These houses are "demountable homes," in which walls and roof unfold at the homesite to become four-rooms-and-bath. Erecting them used to call for 16 men and a crane. Now, says B. F. Goodrich, an inflatable bag does the trick in three minutes. It's positioned under the roof section, and inflated by an air compressor (or even a tank-type vacuum cleaner if one is handy). The roof is then supported by props, the bag is deflated, and down sinks the floor—right into place.

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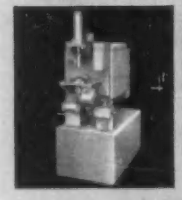

. . . with typical tooling for assembling parts and injecting PERMAWICK into sleeve bearing lubrication cavities . . . *in one automatic operation.*

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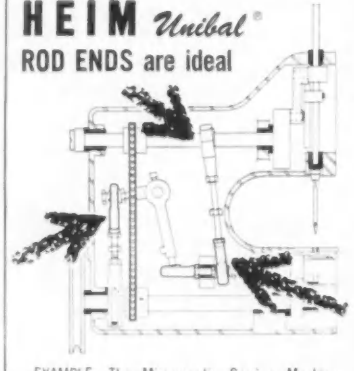

EXAMPLE: The Minneapolis Sewing Machine Co. uses three Heim Unibal Rod Ends in the linkage of their Portable Sewing Machine to take care of a 25° operating misalignment.

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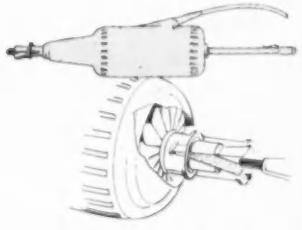
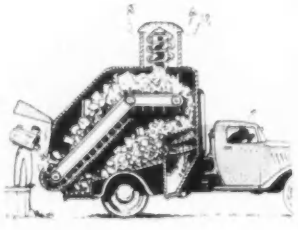


. . . incorporate a pencil sharpener in electric erasing machines used by draftsmen? It would require a motor with a double-ended shaft, the sharpener end fitted with abrasive paper or blades suitable for automatic lead pencils (not the wooden kind). Careful design would prevent carbon dust from fouling the motor and permit easy changing of abrasives. Maximum cost: under $20—H. Belofsky



. . . an incinerator on wheels so that a trash-collection truck could destroy garbage as it is picked up. Power for running the truck might come from the generated heat and the truck would dump ashes only once a day after its run.

—V. J. Perillo

. . . a flexible, resilient, heat-conducting material? It would find application in shock-mounting electron tubes and other components that need an effective heat sink plus good shock and vibration protection.

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—K. Kahn

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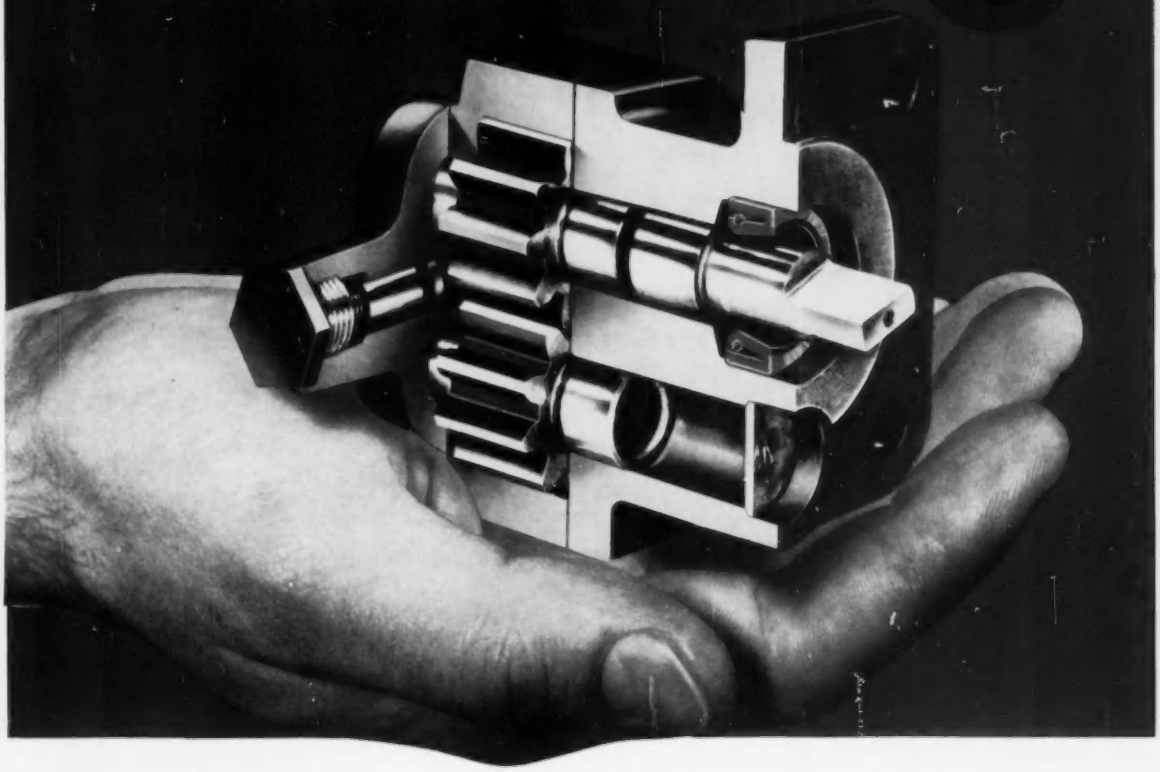

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C/R PRODUCTS: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears

OIL SEAL C/R DIVISION

**CHICAGO RAWHIDE**